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THE DETECTION OF MUTAGENIC PROPERTIES
OF PESTICIDES USED IN COMMERCIAL
CORN PRODUCTION

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FOREWORD

The many benefits of our modern, developing, industrial society are accompanied by certain hazards. Careful assessment of the relative risk of existing and new man-made environmental hazards is necessary for the establishment of sound regulatory policy. These regulations serve to enhance the quality of our environment in order to promote the public health and welfare and the productive capacity of our Nation's population.

The complexities of environmental problems originate in the deep interdependent relationships between the various physical and biological segments of man's natural and social world. Solutions to these environmental problems require an integrated program of research and development using input from a number of disciplines. The Health Effects Research Laboratory conducts a coordinated environmental health research program in inhalation toxicology, genetic toxicology, neurotoxicology, developmental and experimental biology, and clinical studies using human volunteer subjects. These studies address problems in air pollution, water pollution, non-ionizing radiation, environmental carcinogenesis and the toxicology of pesticides and other chemical pollutants. The Laboratory participates in and provides data for the development and revision of criteria documents on pollutants for which national ambient air quality and water quality standards exist or are proposed, provides the data for registration of new pesticides or proposed suspension of those already in use, conducts research on hazardous and toxic materials, and is primarily responsible for providing the health basis for non-ionizing radiation standards. Direct support to the regulatory function of the Agency is provided in the form of expert testimony and preparation of affidavits as well as expert advice to the Administrator to assure the adequacy of environmental regulatory decisions involving the protection of the health and welfare of all U.S. inhabitants.

Mutagenic agents (genotoxins) in the environment pose serious hazards to the public health. One source of these agents is pesticides used in modern agricultural practice. This research conducted under the auspices of the Institute for Environmental Studies at the University of Illinois was designed to evaluate the genotoxicity of pesticides that are widely used in commercial corn production. An important component of the work described in this report is the development of a comprehensive battery of genetic assays that include both plant and animal activation protocols under laboratory and in situ conditions.

F. Gordon Hueter, Ph.D.
Director
Health Effects Research Laboratory

PREFACE

Considering the involvement of chemical pesticides in modern agricultural practice, the determination of the compatibility of these agents with the environment and the public health is exceedingly important. During the last decade a new environmental hazard has been recognized. This hazard is that of environmental mutagens. These physical or chemical agents, that have the ability to alter the genetic material or the proper functioning of the genetic material, pose a serious long-term threat to man and other living organisms. A new branch of toxicology, genetic toxicology, has evolved to detect, investigate and manage environmental mutagens. We contend that it is also a function of geneticists to assist in the evaluation of the potential genetic damage and to define the risks associated with human exposure to these agents. Depending upon the ontogenetic stage of an individual when exposed, an environmental mutagen can exert teratogenic effects, cause mutations involving germinal cells, induce coronary artery disease, affect the aging process or induce mutations of somatic cells that may become neoplastic. We as geneticists are alarmed that there may be large amounts of agents released into our environment that can be deleterious not only to an individual but also to his progeny, generation upon generation. We anticipate that adverse genetic effects can be created in the human species by inadvertent exposure to mutagens. It, therefore, is obvious that the induction of genetic damage by the use of mutagens applied to the environment should be avoided.

We submitted an unsolicited research project proposal to the Health Effects Research Laboratory, U. S. Environmental Protection Agency for funds to conduct the research described in this report. In the United States hundreds of millions of kilograms of pesticides are used annually by the agricultural community. While many uses of pesticides are beneficial we were concerned that an adequate understanding of the mutagenic properties of pesticides was lacking. Furthermore, little information existed on the mutagenic properties of pesticides after animal or plant biological activation. We also wanted to institute in situ (in field) analysis to measure the mutagenic effects of a pesticide on a crop plant under real world conditions.

This research was designed as a demonstration project to investigate the mutagenic properties of a group of pesticides employed in the production of a significant commercial crop in the United States. The crop plant we chose was corn, Zea mays because it is a major agricultural commodity, a large number of pesticides are used in commercial corn production and corn is a well defined genetic tool that is amenable as an in situ genetic indicator organism for mutation induction. We employed three genetic indicator organisms, a prokaryote, a lower eukaryote and a higher eukaryote and established a comprehensive data base to resolve a spectrum of genetic damage that a pesticide or combination of pesticides may induce. Finally we introduced the use of

an in vivo plant activation protocol to complement the in vitro mammalian microsomal activation system in current use with most microbial genetic assay systems. It was our intention that this demonstration project be used to evaluate pesticides for their mutagenic properties under laboratory conditions and under the conditions of modern agricultural practice.

ABSTRACT

This project encompassed the analysis of 21 pesticides and 12 combinations of herbicides for their genotoxic properties. Three genetic assays were employed; reverse mutation in Salmonella typhimurium, gene conversion in Saccharomyces cerevisiae and reverse mutation in Z. mays. The use of these genetic indicator organisms established a comprehensive data base that resolved a spectrum of genetic damage induced by single agents or by combinations of agents. The pesticides were evaluated with the microbial assays directly, after in vitro mammalian microsomal activation and after in vivo plant activation protocols. Finally all the pesticides were tested for their ability to induce mutations in Z. mays under in situ (in field) conditions.

This project was divided into two options. Option one included pesticides from a wide range of chemical classes and the entire spectrum of genetic assays and activation protocols were used. Option two was included to gather additional information on the genotoxic properties of s-triazine herbicides. The range of genetic assays used in option two was abridged.

Of the insecticides assayed, curacron, carbofuran, chlorpyrifos, metham and phorate were negative in all assays. Two insecticides, terbufos and ethoprop were positive in one assay. Chlordane, fonofos and heptachlor were positive in two of the three genetic assays. No insecticide was positive in all three assays.

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The combinations of herbicides tested under option one were assayed under the condition of in vivo plant activation. All the herbicide combinations were positive in one of the three assays except metolachlor plus atrazine which was positive in two assays.

The herbicides and combinations of herbicides tested in option two were evaluated with the maize wx locus assay only. Only butylate and the combination of butylate plus cyanazine were negative in the maize assay.

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SUMMARY

This project encompassed the analysis of 21 pesticides and 12 combinations of herbicides for their genotoxic properties. Three genetic assays were employed; reverse mutation in Salmonella typhimurium, gene conversion in Saccharomyces cerevisiae and reverse mutation in Zea mays. The results of this project are summarized in Table 1. A list of the pesticides evaluated for their genotoxic properties is presented in Table 2. The common and chemical names for the pesticides used in this report were those indicated by the U. S. EPA publication (EPA-600/2-81-011) entitled, "Analytical Reference Standards and Supplemental Data for Pesticides and Other Organic Compounds" R. R. Watts, Ed. For an agent to be considered genotoxic the following criteria were imposed. For the Salmonella assay a test agent with or without activation was appraised as positive if it induced an increase in the number of revertants per plate that was twice the appropriate control value (Ames et al., 1975) or if the highest dose tested indicated a significant θ value (Katz, 1979). In addition the agent had to induce a reproducible dose dependent response (Ames et al., 1975; de Serres and Shelby, 1979). For the Saccharomyces assay a test agent was considered as positive if it induced an increase in the number of convertants per 10^5 survivors that was twice the control value or if the highest dose tested indicated a significant θ value (Katz, 1979). Additionally the agent had to induce a reproducible dose dependent response. When the microbial assays were conducted, the agents were evaluated directly, with in vitro mammalian microsome activation (S-9) or with in vivo plant activation (1S) protocols. For the maize test the agent was appraised as positive if it induced an increase in the mutation rate among gametophytes that was twice the control value or indicated a significant θ value (Katz, 1979). In addition a significant t-test was required for each agent. These statistical requirements were imposed to aid in the interpretation of the data and to reduce the type one and type two errors that may arise when a large number of agents are assayed with a variety of genetic indicator organisms.

This project was divided into two options. Option one included pesticides from a wide range of chemical classes and the entire spectrum of genetic assays and activation protocols were used. Option two was included to gather additional information on the genotoxic properties of s-triazine herbicides. The range of genetic assays used in option two was abridged.

Of the insecticides assayed, curacron, carbofuran, chlorpyrifos, metham and phorate were negative in all assays. Two insecticides, terbufos and ethoprop were positive in one assay. Chlordane, fonofos and heptachlor were positive in two of the three genetic assays. No insecticide was positive in all three assays.

Of the herbicides assayed under option one of this project, eradican and bifenox were negative in all assays. Alachlor, propachlor, procyzine and SD50093 were positive in one assay. Cyanazine, dicamba and metolachlor were positive in two assays; no herbicide was found to be positive in all three assays.

The combinations of herbicides tested under option one were assayed under the condition of in vivo plant activation. All the herbicide combinations were positive in one of the three assays except metolachlor plus atrazine which was positive in two assays.

The herbicides and combinations of herbicides tested in option two were evaluated with the maize ~~wx~~ locus assay only. Only butylate and the combination of butylate plus cyanazine were negative in the maize assay.

TABLE 1. SUMMARY OF RESULTS

Pesticide (Option 1)	Genetic Assays						
	<u>S. typhimurium</u>			<u>S. cerevisiae</u>			<u>Z. mays</u>
	D	S-9	1S	D	S-9	1S	WX
Alachlor (H,C)	-	-	-	+	-	-	-
Alachlor (H,T)	-	-	-	-	-	+	NA
Bifenox (H,C)	-	-	-	-	-	-	-
Bifenox (H,T)	-	-	-	-	-	-	NA
Curacron (I,C)	-	-	-	-	-	-	-
Curacron (I,T)	-	-	-	-	-	-	NA
Carbofuran (I,C)	-	-	-	-	-	-	-
Carbofuran (I,T)	-	-	NT	-	-	-	NA
Chlordane (I,C)	-	-	-	-	+	+	+
Chlordane (I,T)	-	-	-	-	+	-	NA
Chlorpyrifos (I,C)	-	-	-	-	-	-	-
Chlorpyrifos (I,T)	-	-	-	-	-	-	NA
Cyanazine (H,C)	-	-	+	-	-	-	+
Cyanazine (H,T)	-	-	+	-	-	NT	NA
Dicamba (H,C)	+	-	-	-	-	-	-
Dicamba (H,T)	+	-	+	-	+	-	NA
Eradicane (H,C)	-	-	-	-	-	-	-
Eradicane (H,T)	-	-	-	-	-	-	NA
Ethoprop (I,C)	NT	NT	NT	NT	NT	NT	+
Ethoprop (I,T)	NT	NT	NT	NT	NT	NT	NA
Fonofos (I,C)	-	+	-	-	-	-	-
Fonofos (I,T)	-	+	-	+	-	-	NA
Heptachlor (I,C)	-	-	-	-	-	-	+
Heptachlor (I,T)	-	+	+	-	-	-	NA
Metolachlor (H,C)	+	+	-	-	+	-	-
Metolachlor (H,T)	-	-	-	-	-	-	NA
Phorate (I,C)	-	-	-	-	-	-	-
Phorate (I,T)	-	-	-	-	-	-	NA
Procyazine (H,C)	-	-	NT	-	-	NT	-
Procyazine (H,T)	-	+	+	-	-	-	NA
Propachlor (H,C)	-	-	-	-	-	+	-
Propachlor (H,T)	-	-	-	-	-	+	NA
SD50093 (H,C)	-	-	NT	-	-	NT	+
SD50093 (H,T)	-	-	NT	-	-	NT	NA
Metham (I,C)	-	-	-	-	-	-	-
Metham (I,T)	-	-	-	-	-	-	NA
Terbufos (I,C)	-	-	-	+	-	-	-
Terbufos (I,T)	-	-	-	+	+	-	NA

TABLE 1 (Continued)

Pesticide (Option 1)	Genetic Assays						
	<u>S. typhimurium</u>			<u>S. cerevisiae</u>			<u>Z. mays</u>
	D	S-9	LS	D	S-9	LS	<u>WX</u>
Alachlor + Bifenox			+			-	-
Alachlor + Dicamba			+			-	-
Cyanazine + Alachlor			+			-	-
Cyanazine + Propachlor			+			-	-
Metolachlor + Atrazine			+			-	+
Metolachlor + Dicamba			-			+	-
Procyazine + Metolachlor			-			+	-

Pesticide (Option 2)							

Atrazine							+
Butylate							-
Butylate + Atrazine							+
Butylate + Cyanazine							-
Eradicane + Atrazine							+
Eradicane + Cyanazine							+
Metolachlor + Atrazine							+
Metolachlor + Cyanazine							+
Simazine							+

H = herbicide, I = insecticide, C = commercial grade, and T = Techni grade.							

TABLE 2. PESTICIDES EVALUATED FOR THEIR GENOTOXIC PROPERTIES

Insecticides			
Common Name	Trade Name	Chemical Name	CA Reg. No.
Chlordane	Chlordane	1,2,4,5,6,7,8,8-Octachloro-2,3,3a,4,7,7a-hexahydro-4,7-methanoindene and related compounds	57-74-9
Terbufos	Counter	S-[[[(1,1-Dimethylethyl) thio] methyl] 0,0-diethyl phosphorodithioate	13071-79-9
Fonofos	Dyfonate	O-Ethyl S-phenyl ethyl-phosphonodithioate	944-22-9
Heptachlor	Heptachlor	1,4,5,6,7,8,8-Heptachloro-3a,4,7,7a-tetrahydro-4,7-methanoindene	76-48-8
Carbofuran	Furadan	2,3-Dihydro-2,2-dimethylbenzo-furan-7-yl methylcarbamate	1563-66-2
Chlorpyrifos	Lorsban	0,0-Diethyl O-(3,5,6-trichloro-2-pyridyl) phosphorothioate	2921-88-2
Ethoprop	Mocap	O-Ethyl S,S-dipropyl phosphorodithioate	13194-48-4
Phorate	Thimet	0,0-Diethyl-S-[(ethylthio) methyl] phosphorodithioate	298-02-2
Curacron	CGA	O-(4-bromo-2-chloro-phenyl)-O-ethyl-S-propyl phosphorothioate	
Metham	SRA	Sodium methyldithiocarbamate	6734-80-1

TABLE 2 (Continued)

Herbicides			
Cyanazine	Bladex	2-[(4-Chloro-6-(ethylamino)-s-triazin-2-yl]-2-methylpropionitrile	21725 -46-2
Eradicane	Eradicane (EPTC)	S-Ethyl dipropylthiocarbamate	759-94-4
Alachlor	Lasso	2-Chloro-2',6'-diethyl-N-(methoxymethyl) acetanilide	15972-60-8
Bifenox	Modown	Methyl 5-(2,4-dichlorophenoxy)-2-nitrobenzoate	42576-02-3
Procyazine	Cycle	2-[[4-Chloro-6-(cyclopropylamino)-s-triazin-2-yl]amino]-2-methylpropionitrile	32889-48-8
Metolachlor	Dual	2-Chloro-N-(2-ethyl-6-methylphenyl)-N-(2-methoxy-1-methylethyl) acetamide	51218-45-2
Propachlor	Ramrod	2-Chloro-N-isopropylacetanilide	1918-16-7
Simazine	Princep	2-Chloro-4,6-bis(ethylamino)-s-triazine	122-34-9
Atrazine	Aatrex	2-Chloro-4(ethylamino)-6-(isopropylamino)-s-triazine	1912-24-9
Butylate	Sutan	S-Ethyl N,N-diisobutylthiocarbamate	2008-41-5
Dicamba	Banvel	2-Methoxy-3,6-dichlorobenzoic acid 3,5-Dichloro-O-anisic acid	1918-00-9
SD50093	SD50093	Formulation of Atrazine plus Cyanazine	

INTRODUCTION

This research project was instituted not only to detect possible environmental chemical mutagens used in a specific agricultural segment but also to consider a series of conditions under which a pesticide may be evaluated. Although pesticides are used in the field, toxicological assessment is usually conducted in the laboratory. We used both of these conditions in order to make the information concerning the mutagenic properties of each chemical meaningful under real world situations.

To achieve the above goals the data base must be comprehensive in a biological sense. The genetic indicator organisms employed were chosen because of their phylogenetic characteristics. Two microbial indicator organisms were used; the prokaryote *S. typhimurium* and the lower eukaryote *S. cerevisiae*. The higher eukaryote indicator organism was the angiosperm plant, *Z. mays*. Thus our genetic indicator organisms covered a very broad evolutionary base. Two types of genetic events were scored, reverse mutation in *S. typhimurium* and *Z. mays* and gene conversion in *S. cerevisiae*.

Each pesticide was tested directly with the microbial indicator organisms. Each chemical was also tested after treatment with an *in vitro* mammalian microsomal fraction (S-9) or with an *in vivo* plant activation (1S) protocol. This approach permitted the detection of direct acting chemical mutagens from those that were promutagens requiring biological activation to convert the agent to its ultimate mutagenic form. Finally each pesticide was evaluated under agricultural field conditions for its ability to induce mutation in inbred W22 *Z. mays*.

This project encompassed the analysis of ten insecticides, 11 herbicides and 12 combinations of herbicides (Table 2). Of the above number of pesticides, ten insecticides, nine herbicides and six combinations of herbicides were subjected to the entire battery of genetic assays. A second set of two herbicides and six combinations of herbicides were analyzed only under *in situ* conditions using the maize *wx* locus assay.

RECOMMENDATIONS

Since the overwhelming majority of pesticide use is applied to or on plant species it is incumbent to incorporate plant dependent assays in the evaluation of their mutagenic properties. Short-term genetic assays are useful in defining a chemical as a mutagen. We recommend that a diversity of genetic indicator organisms, prokaryote and eukaryote species, be used with different endpoints for studies on pesticides. It is important to include systems that detect the activation of promutagens into active mutagens. We recommend the use of both mammalian and plant activation protocols. In this study, 36 single pesticide formulations were tested and we identified 10 that were positive after mammalian S-9 activation while nine were positive after 1S plant activation (Table 1). Among this group of promutagens, only three agents were positive after animal and plant activation. This demonstration of plant activation of pesticides amplifies our concern for the need for appropriate and comprehensive assays for environmental genotoxins. This study was unique in that it, for the first time, compared the mutagenic properties of pesticides associated by their use in the production of a commercial crop, after both animal and plant activation. This study is also unique in that the commercial grade of each pesticide was evaluated for its mutagenicity in maize pollen grains under field conditions. We strongly recommend that pesticides be evaluated with appropriate in situ assays under conditions of modern agricultural practice. This would provide data that are consistent with the ways these agents are used. Analysis under laboratory conditions need to be complemented with in situ genetic analysis of pesticides used in the agricultural environment.

MICROBIAL ASSAYS

PREPARATION OF S-9

Some mutagens (aflatoxin B₁, dimethylnitrosamine) are inactive unless they are converted to a genotoxic form following animal or plant metabolism. The mammalian microsomal metabolic activation system used in our laboratory is described in Ames et al. (1975).

Adult male rats (Sprague-Dawley, Spartan Laboratories, Haslett, MI) were given a single 500 mg/kg intraperitoneal injection of the polychlorinated biphenyl, Aroclor 1254. Four days following the injection, the animals' food was removed. On the fifth day the rats were sacrificed. The liver of each rat was removed aseptically and placed in preweighed, sterile glass beakers containing known volumes of iced, sterile 0.15 M KCl (1 ml/g of wet organ weight). The organ was washed in an equal volume of 0.15 M KCl, minced with sterile surgical scissors in three volumes of 0.15 M KCl, centrifuged for 10 min at 9,000 g and the supernatant fluid was removed and stored in liquid nitrogen. The postmitochondrial supernatant fluid was added to an activation mixture immediately prior to each experiment. The working solution of the activation mixture consisted of (final concentrations) 8 umoles MgCl₂, 33 umoles KCl, 5 umoles glucose-6-phosphate, 4 umoles NADP and 100 umoles sodium phosphate, pH 7.4. Homogenates and activation mixtures were stored for no more than two months in sterile dram vials, 5 ml to a vial, at -80 C.

PREPARATION OF MAIZE 1S FRACTIONS

Each pesticide studied in this project was analyzed for *in vivo* plant activation. The maize first solvent fraction (1S) was prepared from seedlings grown in various concentrations of the test agent. The preparation of the 1S fractions was as follows. Twenty kernels of *Z. mays* inbred B37 were placed in water resistant paper containers that measured 8.5 cm in diameter and 8.5 cm in height. The paper containers were filled with approximately 70 g of clean vermiculite in which the kernels were planted. A duplicate planting of controls and usually three different treatment groups were prepared per experiment. For each control vessel 150 ml of water was added while the treatment groups received various concentrations of the test agent dissolved in the water. In all cases the amount of water added to each container was the same. If the test agent was relatively insoluble in water, the chemical was dissolved in dimethylsulfoxide and then diluted with an appropriate amount of water. Each container was covered with a porous top and placed in a plant growth chamber. The plant growth chamber was set to provide a photoperiod of 15 h of mixed fluorescent and incandescent

lamps. The day and night temperatures were 25 C and 20 C, respectively. After three days the top of each container was removed and each container received equal amounts of water, approximately 50 ml per day. After the plants grew to the three-leaf stage of development the seedlings from each group were separately removed from the container and the vermiculite was carefully washed off the roots. The endosperm from each seedling was removed and discarded. The plants were weighed, minced into a VirTis glass homogenation vessel and five volumes (w/v) of distilled water was added. The plants were homogenized and filtered and the filtrate was centrifuged at 600 g for 10 min. The supernatant fluid was lyophilized and the dried 1S fraction was placed in a labeled vial, sealed and stored at -22 C. Each control group and treatment group was prepared separately.

SALMONELLA TYPHIMURIUM

General

The *S. typhimurium* strains used at Hope College were obtained from Dr. Bruce Ames of the University of California, Berkeley. All are histidine auxotrophs (*his*⁻) by virtue of mutations in the histidine operon. In addition to the *his*⁻ mutations the indicator strains have mutations for genes that control the synthesis of the lipopolysaccharide coat of the bacterium (*rfa*⁻) and a deletion that covers a gene involved in the repair of ultraviolet damage (*uvrB*). The *rfa*⁻ mutation makes the strains more permeable to large molecules, thereby increasing their sensitivity. The *uvrB* mutation decreases repair of some types of DNA damage and thus enhances sensitivity to some mutagens. Strain TA1535 is reverted to histidine prototrophy (*his*⁺) by many mutagens that cause base pair substitutions. Strains TA1537 and TA1538 are reverted by many frameshift mutagens. TA100 is derived from TA1535 and TA98 is derived from TA1538 by the introduction of the R factor plasmid pKM101. The introduction of this plasmid, which confers ampicillin resistance to the strain, greatly enhances the sensitivity of TA100 to some base-pair substitution mutagens and TA98 to some frameshift mutagens. For example, it has been shown that mutagens such as acrylamide can be detected in plate assays by TA100 but not by TA1535. The presence of the pKM101 plasmid in TA100 also makes this strain more sensitive to some frameshift mutagens (e. g. ICR-191, aflatoxin B1 and benzo(a)pyrene).

Experimental

All indicator strains were stored at -80 C. For each experiment an inoculum from frozen stock cultures was grown overnight at 37 C in trypticase soy broth. After stationary overnight growth, the cultures were shaken for 2 to 3 h to insure optimal growth.

In standard testing protocol a sterile 13 x 100 mm test tube was placed in a 44 C heating block. To each test tube we added the following materials in order, 1) 2 ml of 0.6% agar that contained 0.05 mM histidine and 0.05 mM biotin, 2) 0.1 ml of the bacterial culture, 3) 0.5 ml of the metabolic activation mixture (optional) and 4) up to 100 ul of a solution of the test agent.

The mutability of each strain was routinely tested in each experiment with 2-nitrofluorene (TA1535 and TA98), sodium azide or N-methyl-N'-nitro-N-nitrosoguanidine (TA1535 and TA100) and 9-aminoacridine (TA1537). The general range of spontaneous mutant colonies per plate for each strain in our laboratory was, TA1535 (5-20), TA1537 (3-15), TA1538 (10-20), TA98 (30-90) and TA100 (75-150). The activation of aflatoxin B1 was used as an index of S-9 activity. For negative controls we used steps one, two and three of the standard testing protocol with 100 ul of the solvent used with the test agent.

This mixture was stirred gently and poured onto minimal agar plates. Minimal agar plates consisted of 15 g agar, 20 g glucose, 0.2 g $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$, 2 g citric acid monohydrate, 10 g K_2HPO_4 and 3.5 g $\text{NaH}_2\text{PO}_4 \cdot \text{H}_2\text{O}$ per liter of sterile distilled water. After the soft agar set, the plates were incubated at 37 C for 2 days. The number of his^+ revertants (colonies that grew on plates lacking a sufficient amount of histidine to support colony formation) were counted and recorded. Some of the revertants were routinely tested to confirm that they were his^+ , required biotin and were sensitive to crystal violet (rfa^-).

The testing regimen used in the Salmonella test was modified slightly when maize 1S fractions were analyzed for mutagenic activity. The lyophilized 1S fraction was dissolved in an appropriate solvent and filter sterilized with a Falcon 7102 disposable filter (H.A. 0.45 μm). We then used steps one and two as outlined in the standard testing protocol. However, in step three, 0.5 ml of sterile 1S filtrate was added in place of the S-9 activation mixture. No additional chemical was added since the 1S fractions were derived from maize plants treated with the agent under study. This mixture was stirred gently and then poured onto minimal agar plates. Normal evaluation procedures for mutagenicity were followed.

For routine analysis each chemical was tested for mutagenicity over a wide dose range in duplicate experiments. Each experiment consisted of three replica plates for each chemical concentration for every Salmonella strain under direct and under activation regimes. Mean values were calculated from the total number of plates in both experiments.

Every two weeks each culture of S. typhimurium was checked for sensitivity to crystal violet. The presence of the rfa^- mutation makes the indicator strains sensitive to this dye whereas the parent strain, rfa^+ , is not. However, the mutation is reversible, leading

to the accumulation of rfa⁺ cells in the culture. Therefore, the cells must be analyzed routinely to insure their sensitivity to crystal violet. Every three months each permanent stock was tested for ultraviolet sensitivity and histidine auxotrophy and TA98 and TA100 were tested for the presence of the plasmid pKM101. In addition each culture was tested by specific mutagens known to revert each test strain (positive controls).

SACCHAROMYCES CEREVISIAE

General

The S. cerevisiae strain used at Hope College was obtained from Dr. F. K. Zimmermann of the Fachbereich Biologie, Mykologie/Genetik, Darmstadt, FDR. This diploid strain is heteroallelic at two loci, ade 2-1/ade 2-2 and trp 5-12/trp 5-27. Mitotic gene conversion, a process of nonreciprocal transfer of small lengths of DNA between homologous regions of chromatids of homologous chromosomes, can be induced in this strain at either locus by all chemicals normally mutagenic in yeast. Induction of mitotic gene conversion can be followed by plating D4 cells on two different selective media. Plating on tryptophan-free medium selects for convertants at the trp-5 locus whereas plating on adenine-free medium selects convertants at the ade-2 locus (Zimmermann, 1975).

Experimental

Stock isolates of D4 were kept on silica gel at 4 C and on Y agar slants (10 g bacto-peptone, 10 g yeast extract, 30 g glucose, 15 g agar per liter H₂O.) The stock isolates on slants were checked for spontaneous conversion events every month, while the stock isolates on silica gel were checked for spontaneous conversion every three months.

For each experiment an inoculum from stock slant isolates was inoculated into Y broth and grown overnight with agitation at 30 C. Cells were harvested at mid to late log phase of growth, centrifuged, and resuspended in sterile 0.05 M potassium phthalate buffer (pH 5.1). The cells were washed and pelleted three times after which the cells were counted in a hemacytometer. A final cell suspension of approximately 3 X 10⁷ cells/ml was prepared in sterile water.

The cells were treated in the following manner:

1. The chemical to be tested was dissolved in an appropriate solvent and buffered with a final concentration of solvent not exceeding 10 percent.
2. A dilution series of the chemical was made in steps of 1:3, 1:10, 1:30 (optional) and 1:100.

3. Aliquots of the dilutions (4.5 ml) were pipetted into sterile 13 x 100 mm test tubes and the tubes placed into a 30 C water bath for temperature equilibration.
4. Treatment was initiated by pipetting 0.5 ml aliquots from the stock cell suspension into tubes with the chemical. Treatments were performed with shaking for 30 minutes.
5. Treatments were terminated by adding 5 percent $\text{Na}_2\text{S}_2\text{O}_3$ and chilling in an ice bath. The cells were centrifuged, collected as a pellet and the pellet resuspended in sterile distilled water. The washing process was repeated once and the cells were resuspended in a final volume of 5 ml of sterile water.
6. An aliquot (0.1 ml) of the cell suspension was plated undiluted on either tryptophan free medium or adenine-free medium (five plates per concentration). These plates were used for the calculation of the gene conversion frequencies.
7. Dilutions of the cell suspension were made in steps of 1:10, 1:100 and 1:1,000 in sterile water. We plated 0.1 ml aliquots of each dilution on χ complete medium agar plates. These plates were used to calculate the percent cell survival.

After 4 days incubation at 30 C, colonies on χ agar plates were scored and after 6 days incubation at 30 C, colonies on the minimal agar plates were scored. Survival frequencies were computed by dividing the number of colonies counted on the same number of control plates. Conversion frequencies were calculated by determining the number of viable cells on the plates selective for convertants (this is done by multiplying the number of colonies on χ agar plates by the dilution factor) and then dividing the number of convertant colonies present on the selective media by the number of viable cells. Convertant frequencies are expressed per 10^5 survivors.

Mitotic gene conversion at both loci was routinely monitored using N-methyl-N'-nitro-N-nitrosoguanadine or aflatoxin B₁. Spontaneous gene conversion frequencies in our laboratory were 0.5 to 5×10^5 survivors for the ade locus and 0.3 to 5×10^5 survivors for the trp locus.

For experiments that involved S-9 activation, all procedures were the same (steps one through seven), however, the initial cell suspension of 3×10^7 cells/ml was prepared in sterile S-9 plus activation mixture rather than in sterile water. For experiments involving 1S, all procedures were done in sterile water and treatment of the cells was identical with the standard protocol (steps three through seven). However, since the 1S fractions reflect tissue samples from plants treated with a concentration of the test agent, these samples were not

diluted. After solubilizing the lyophilized LS fraction in an organic solvent to a concentration of 30 mg/ml, the LS material was filter sterilized and 4.5 ml of this material was added to a test tube.

For routine testing a single concentration of each chemical was prepared and diluted in accordance with the methods outlined above. The dilution series provided the dose range for the test agent. Each experiment was run in duplicate, with a single experiment consisting of five replica platings of cells for each locus for each chemical dilution. Mean values were calculated from the total number of plates in both experiments.

STATISTICAL ANALYSIS FOR MICROBIAL ASSAYS

The data collected for each pesticide or combination of pesticides were evaluated by using three statistical parameters. These parameters were:

1. A determination of the doubling (2x of the appropriate control value) of either the number of histidine revertants/plate in the Salmonella test or the number of gene convertants/ 10^5 survivors in the Saccharomyces test.
2. A test for significance in the Salmonella test or a test for significance in the Saccharomyces test.
3. A dose dependent response in one or more of the Salmonella strains or at one of the two loci tested in Saccharomyces.

The mean number of histidine revertants found on the control plates was compared with the highest mean number of histidine revertants found on any one series of experimental plates. The number of revertant colonies found on control plates was multiplied by a value of two and compared to the treatment group plates. If the average number of colonies for a treatment group exceeded this value the pesticide was said to have induced a mutagenic response. The doubling values for the Saccharomyces test were calculated in a manner similar to that used for Salmonella. The mean number of gene convertants/ 10^5 survivors obtained for control plates was multiplied by two. This value was then compared to the mean numbers of convertants/ 10^5 survivors obtained in the serial dilutions of a given chemical. If the mean number of convertants/ 10^5 survivors in any one of the experimental series was greater than the doubled number of spontaneous convertants, the pesticide was considered to have induced a recombinogenic response.

Katz (1978, 1979) developed a statistical analysis for mutagenicity experiments involving microorganisms. For the Salmonella assay the θ statistic and for the Saccharomyces the ϕ statistic as described by Katz were used.

For the statistical analysis of the Salmonella data, comparisons were made between the mean number of revertants/plate obtained on control plates and the mean number of revertants/plate induced by the highest dose of a test agent. The formula is expressed as:

$$\theta = \frac{a(M-0.5) - b(m+0.5)}{\sqrt{ab(M+m)}}$$

where

1. a = the number of replicate plates for a given concentration of pesticide.
2. b = the number of replicate plates of the solvent, S-9 or 1S control.
3. M = the total number of revertants scored on the experimental plates.
4. m = the total number of revertants scored on the control plates.

Using a 2.5 percent significance level, pesticides were judged to be mutagenic only if θ was found to be greater than 1.96 (value from a standard normal table).

For the statistical analysis of the Saccharomyces data, comparisons were made between the number of convertants/ 10^5 survivors obtained on control plates and the treatment that induced mean number of convertants/ 10^5 survivors. The formula is expressed as:

$$\phi = \frac{a(M-0.5) - Kb(m+0.5)}{\sqrt{Kab(M+m)}}$$

where

1. a = the number of replicate plates for a given concentration of pesticide.
2. b = the number of replicate plates for the solvent, S-9, or 1S control.

3. M = the total number of convertants scored on the experimental plates.
4. m = the total number of convertants scored on the control plates.
5. $K = N/n$ (N = the average number of survivors in the experimental group and n = the average number of survivors in the control group).

Using a 2.5 percent significance level, pesticides were judged to be recombinogenic only if $\emptyset$ was found greater than 1.96 (from a standard normal table).

de Serres and Shelby (1979) suggested that a dose dependent response be used as one measure for mutagenicity of a chemical agent. From our data we judged a pesticide to be mutagenic only if a dose dependent response was clearly obtained. Normally a dose response curve consisted of four points. The same criteria were applied to both the Salmonella and to the Saccharomyces assays.

RESULTS AND DISCUSSION OF MICROBIAL DATA

Statistical summaries of all microbial data are given in Tables 3 through 18. Specific data accumulated for a given insecticide, herbicide, or combination of herbicides can be found in Tables 20 through 105.

Of the insecticides, five chemicals, curacron, carbofuran, chlorpyrifos, metham, and phorate were negative in all assays. The insecticides fonofos and heptachlor were found mutagenic to S. typhimurium. Both the commercial and technical grades of fonofos were positive to Salmonella following S-9 activation whereas only the technical grade of heptachlor was mutagenic to Salmonella following either plant or S-9 activation. The insecticides terbufos, chlordane, and fonofos were all recombinogenic to S. cerevisiae. The commercial grade of terbufos was recombinogenic either directly or following S-9 activation and the commercial and technical grades of fonofos were recombinogenic either directly or following S-9 activation. Fonofos was the only insecticide tested to give a positive response in both the S. typhimurium and S. cerevisiae assays.

Of the herbicides assayed on option one of this project, only eradican and bifenox were negative in all microbial assays. The herbicides cyanazine, dicamba, procyzazine, and metolachlor were all mutagenic to S. typhimurium. Both commercial grade and technical grades of dicamba were directly mutagenic. Additionally, the technical grade of metolachlor was mutagenic following plant activation. The commercial

grade of metolachlor was mutagenic either directly or following S-9 activation. The technical grade of procyzine was mutagenic following either S-9 or plant activation, whereas both the commercial grade and technical grade of cyanazine were found mutagenic only after plant activation. The herbicides alachlor, dicamba, metolachlor and propachlor were found recombinogenic to *S. cerevisiae*. Both the commercial and technical grades of alachlor were recombinogenic either directly or following plant activation. The technical grade of dicamba and the commercial grade of metolachlor were each recombinogenic only after S-9 activation while both the commercial and technical grades of propachlor were recombinogenic only after plant activation. The herbicides dicamba and metolachlor were positive in both microbial assays.

Herbicide combinations were tested for genetic effects under conditions of plant activation. All combinations tested were positive in one assay. The combinations of cyanazine plus alachlor, cyanazine plus propachlor, alachlor plus dicamba, metolachlor plus atrazine, and alachlor plus bifenox were mutagenic to *S. typhimurium* while the combinations of metolachlor plus dicamba and procyzine plus metolachlor were recombinogenic to *S. cerevisiae*. No herbicide combination was found positive in both microbial assays. It is interesting to note that each herbicide combination included at least one herbicide which gave a positive response when tested alone. Therefore, it is not surprising to find a positive response for each combination tested.

ZEA MAYS ASSAY

GENERAL

Indian corn or maize (Z. mays) is an angiosperm plant that is a member of the grass family. Maize is a cultivated grain and a major agricultural product of the United States (Jiler, 1978). Maize is a good genetic indicator for genotoxins because more genetic information exists for maize than for any other plant species. Z. mays is a higher eukaryote with a diploid number of $2n = 20$ chromosomes; its chromosomes are of suitable size for cytogenetic studies and a large body of information exists on maize cytogenetics (Carlson, 1977). The ten linkage groups of maize are well mapped (Coe and Neuffer, 1977; Neuffer et al., 1968) and controlled genetic crosses are easy to perform with hundreds of progeny produced from each cross.

THE WAXY LOCUS POLLEN ASSAY

Since the microgametophyte (pollen grain) is a functional haploid, studies can be conducted that measure the mutation rate among germinal cells (as opposed to the mutation rate in developmental somatic cells per locus per generation). The test requires a moderate amount of time because no crosses are required. The advantage of this assay is that the pollen grain is the unit of measurement, therefore, large numbers can be analyzed providing the assay with a high degree of genetic resolution.

The waxy (wx) locus is located in the short arm of chromosome 9 at position 9-59. The wx locus controls the synthesis of the carbohydrate amylose. Genetic studies confirmed that the waxy allele is recessive to starchy (Wx) and wx segregates in the F_2 generation as a Mendelian monohybrid (Collins, 1909; Collins and Kempton, 1909). In waxy kernels, the starch of the endosperm contains only amylopectin, while in kernels possessing the dominant allele, Wx, the endosperms contain starch with a carbohydrate composition of both amylose and amylopectin (Weatherwax, 1922; Sprague et al., 1943). The presence of amylose in kernels with a Wx allele causes a blue-black color when an iodine solution is placed on the endosperm. When an iodine solution is reacted with endosperms of kernels homozygous for wx a light red color is produced. The iodine test also works with pollen grains. A pollen grain carrying a Wx allele can synthesize amylose and this carbohydrate will form part of its starch content. The exposure of a Wx carrying pollen grain with an iodine solution will cause the pollen grain to appear black.

The starch type of a pollen grain is controlled by the genetic constitution of that pollen grain and not by the parental sporophyte.

Therefore, a genetic reversion (back mutation) of wx to Wx can be detected by scoring for pollen grains obtained from sporophytes that are homozygous wx that stain a black color after treatment with an iodine solution. Likewise, forward mutation can also be measured by scoring tan staining wx carrying pollen grains obtained from plants that are homozygous for the Wx allele.

Studies have confirmed that pollen from maize plants treated with ionizing radiation demonstrated a clear dose dependent response in the mutation rate among gametophytes. Although a number of studies have reported increased forward mutation rates after acute and chronic exposure to ionizing radiation (Eriksson, 1963; 1969; 1971; Eriksson and Tavrin, 1965; Nettancourt, et al., 1977) we shall limit our discussion to reverse mutation at the wx-C and wx-90 heteroallelic sites in the wx locus of maize. Briggs and Smith (1965) analyzed the effect of X-radiation on the reversion frequencies of three wx heteroalleles wx-H21, wx-C and wx-90 and on the frequency of intragenic recombination among three different combinations of heteroalleles. They found an increase in the reversion frequency of wx-90 to Wx and a significant decrease in intragenic recombination between wx-C and wx-90. Bianchi and Tomassini (1965) analyzed the effect of increased X-radiation on maize plants heteroallelic for various wx mutational sites. He analyzed the effect of increased X-radiation (0 to 1680 R) on plants heteroallelic for the following genotypes wx-H21/wx-90, wx-C/wx-H21 and wx-90/wx-C. The induction of Wx pollen grains was scored. Only the wx-H21/wx-90 heteroallelic combination showed a significant increase in the frequency of Wx pollen grains. However, a direct dose dependent response for the induction of aborted pollen grains was observed in all genotypes. Of great interest was the fact that in homoallelic plants for wx-C or wx-90 an increase in revertant Wx pollen grains over the spontaneous frequency in controls was demonstrated. For wx-C the exposure of 0, 800 R, and 1,600 R of X rays gave frequencies of revertant pollen grains of 1.2, 7.5, and 5.0×10^5 respectively. For wx-90 the same radiation doses induced frequencies of revertant pollen grains of 2.3, 5.6 and 11.5×10^5 respectively. Thus wx-C and wx-90 can revert to the dominant allele after exposure to a mutagen.

EXPERIMENTAL

Plants

The plants used throughout the maize wx locus assay were inbred W22 homozygous for the wx-C heteroallele. Inbred W22 kernels were originally obtained from the Maize Genetics Cooperation Stock Center at the University of Illinois. The inbred line was propagated in the genetic nursery of M. Plewa. The wx-C heteroallele was reconfirmed by conducting a cis-trans test with a homozygous wx-C line in inbred M14 supplied to us by Dr. O. E. Nelson of the University of Wisconsin, Madison. No intragenic recombination at the wx locus was observed in

pollen grains from the F₁ progeny, therefore, we certified that the heteroallele used in the maize wx locus reversion assay was wx-C.

In Situ Test Plots

The in situ field plots were constructed at the Illinois Natural History Survey and at the South Farms of the Department of Agronomy at the University of Illinois. The in situ test plots for the evaluation of ten insecticides used in commercial corn production were set up at the Natural History Survey. A series of rows were plowed in an experimental field and each evaluation plot measured approximately 2 m x 0.5 m. Five kernels of homozygous wx-C inbred W22 were planted in each plot. Control plots were distributed within the field. A field grade formulation of each insecticide was applied to its assigned test plot prior to the emergence of the maize seedlings. These test plots were instituted during the 1976 growing season. The application rate in equivalent kg/ha is listed below.

Insecticide	Application Rate (kg/ha)
Curacron	2.24
Chlordane	2.24
Chlordane	4.48
Terbufos	2.24
Fonofos	2.24
Carbofuran	2.24
Heptachlor	1.12
Chlorpyrifos	2.24
Ethoprop	2.24
Metham	2.24
Phorate	2.24

The in situ test plots for the evaluation of herbicides were conducted at the South Farms of the University of Illinois. Each plot was approximately 10 m x 3 m and consisted of three parallel 10 m long rows. The outer two rows were planted with a commercial hybrid corn variety while the center row of each plot was planted with inbred W22, wx-C/wx-C kernels. A field grade formulation of each herbicide or combination of herbicides was applied prior to the emergence of the maize seedlings. Since all of the herbicides were not evaluated in a single year and since some of the weaker inbred maize plants did not survive during a season, three separate plantings were conducted. Herbicides were evaluated in situ during the growing seasons of 1976, 1977 and 1978. The 1977 test plots also included the herbicides and combination of herbicides contracted for testing during option two of this program. The herbicides and combinations of herbicides and their appropriate application rate in equivalent kg/ha are listed below.

Herbicides
1976 Test Plots

Application Rate (kg/ha)

Cyanazine	3.58
Procyazine	3.58
Metolachlor	6.00
Eradicane	0.56
Eradicane	3.36
Bifenox	2.24
SD50093	4.48
Cyanazine + Alachlor	2.24 + 2.24
Procyazine + Metolachlor	2.24 + 2.24
Metolachlor + Dicamba	2.24 + 0.56
Alachlor + Dicamba	2.34 + 0.56
Alachlor + Bifenox	2.34 + 1.12
Alachlor + Bifenox	2.24 + 1.68
Propachlor + Cyanazine	3.36 + 2.24

1977 Test Plots

Atrazine	3.84
Cyanazine	4.80
Metolachlor	8.40
Eradicane	7.20
Alachlor	6.00
SD50093	4.80
Simazine	3.84
Butylate	7.20
Metolachlor + Atrazine	3.00 + 2.40
Metolachlor + Dicamba	3.00 + 0.60
Metolachlor + Cyanazine	4.80 + 4.80
Eradicane + Atrazine	3.60 + 1.92
Eradicane + Cyanazine	3.60 + 2.40
Propachlor + Cyanazine	4.80 + 2.24
Butylate + Atrazine	4.80 + 1.92
Butylate + Cyanazine	4.80 + 2.40

1978 Test Plots

Dicamba	0.56
Propachlor	3.36

Control plots were uniformly distributed within the in situ experimental field for each year. The control plots were identical to the treatment plots except that no herbicide was applied to them. The control and treatment plots were cultivated by hand throughout the growing season and each plant was individually labeled with an experiment number.

Collection and Storage of Tassels

The plants were allowed to grow until early anthesis. This ontogenetic stage is marked by the flowering of the tassel and the extrusion of the anthers from the florets. A tassel was harvested when only a few anthers were dehiscent and the majority of florets were unopened. Each tassel was labeled with the experiment number of the parental sporophyte immediately after its removal. The tassels were dehydrated in a tank of 70 percent ethanol for two days. After such time the tassels were placed in labeled 1 liter jars filled with 70 percent ethanol. Tassels may be stored in ethanol indefinitely. The advantage of the wx locus assay is that the samples can be collected and the genetic endpoint analyzed at a convenient time.

Preparation of Pollen Slides

Each tassel was removed from its storage jar and agitated in clean 70 percent ethanol to remove any contaminant field corn pollen grains from the surface of the tassel. Approximately 15 unopened florets were removed from the tassel and agitated in a petri dish filled with 70 percent ethanol. The anthers were dissected from unopened florets and placed in a stainless steel cup of a VirTis microhomogenizer containing 0.6 ml of a gelatin-iodine stain. The gelatin-iodine stain was prepared as follows. The stock iodine solution consisted of 25 ml deionized water, 500 mg potassium iodide and 95 mg iodine. The potassium iodide was dissolved in 5 ml of water and the iodine was added before diluting the solution to a volume of 25 ml with water. The stock gelatin solution was prepared by mixing 25 ml of heated deionized water and 1.5 g bacteriological gelatin. Each day a fresh gelatin-iodine stain was made by mixing equal volumes of the stock iodine solution and the stock gelatin solution plus a drop of the detergent "Tween-80". The anthers were minced with scissors and homogenized for 30 sec. The homogenate was strained through cheesecloth onto the surface of a large microscope slide, and a coverslip was placed upon the pollen suspension. An additional 0.4 ml of stain was placed into the stainless steel cup and the anthers were rehomogenized for 20 sec. The suspension was then used to prepare a second slide. After the pollen suspension solidified the slide was examined under a dissecting microscope at a magnification of 40 X. The black staining pollen grains were counted. The number of pollen grains per slide was estimated by counting the number of pollen grains within 20 randomly chosen 1 mm^2 areas and multiplying this value by an appropriate factor. The random 1 mm^2 areas were

generated by computer and transcribed onto a glass template. The template was used to estimate the total number of pollen grains per slide. After an appropriate number of slides were analyzed for each plant the frequency of revertant pollen grains was calculated by dividing the total number of Wx pollen grains by the total estimated number of pollen grains.

STATISTICAL ANALYSIS FOR LEA MAYS ASSAY

The data collected for each pesticide or combination of pesticides was evaluated by using four statistical parameters. The parameters include:

1. A determination of the doubling of the wx mutation rate among gametophytes from the appropriate controls.
2. A t-test between an appropriate control group with each independent treatment group.
3. A χ^2 test for significance.
4. A determination of the range of the true reverse mutation rate among gametophytes at the wx locus.

The doubling of the mutation rate among gametophytes was calculated by using the best estimate for the average mutation rate among gametophytes for the control plants and multiplying the value by two. If the average mutation rate among gametophytes for a treatment group exceeded this value then the pesticide was said to have induced a mutagenic response.

Engels (1979) developed a series of equations that may be used to estimate the mutation rate among gametes when premeiotic mutational events are involved. Such events may result in a distribution of exceptional gametophytes that is "clustered" as opposed to binomial. The true mutation rate among gametophytes, u , (in contrast to a mutation rate per locus per generation of somatic cells) can be estimated as a weighted average (p_w) or as an unweighted average (p_u). The best estimator is the average with the least variance. The weighted mutation rate among gametophytes, p_w , is expressed as:

$$P_w = m/n$$

where

1. m = the observed number of mutant pollen grains.

2. n = the estimated population of pollen grains analyzed.

The estimate of the variance of p_w (V_w) is expressed as :

$$V_w = \frac{\sum W_i^2 - p_w \sum n_i^2}{n^2 - n_i^2}$$

The weighted average mutation rate among gametophytes describes a distribution of mutant pollen grains that is believed to be meiotic in nature. A second estimator of the mutation rate among gametophytes is the unweighted average mutation rate, p_u , which is expressed as:

$$p_u = (1/K) [\sum (m_i/n_i)]$$

where k is the number of families involved in an experiment. The estimate of the variance of p_u (V_u) is expressed as:

$$V_u = 1/K(K-1) \sum (M_i/n_i)^2 - 1/K^2 (K-1) (\sum m_i/n_i)^2$$

When the effect of clustering is pronounced, the unweighted average mutation rate provides a better approximation of the true mutation rate among gametophytes. The values of p_w , V_w , p_u and V_u are provided for each control and treatment group analyzed by the wx locus assay. The comparison of each treatment group for an average mutation rate that is double or more than the average mutation rate of wx-C among control pollen grains was conducted using the estimator with the least variance.

A t-test is the second test used to determine significant differences between the average mutation rate among gametophytes of the control group and each independent treatment group. That value for each test and the probability for the tests that indicated a significant difference between the estimated mutation rate of the control and mutation rate of the treatment groups are listed in each wx locus table (Tables 106 through 147).

A new statistic ($\emptyset$) has been developed by Katz (1979) to determine if a treatment induced a significant increase in the mutation rate over controls. Katz adapted the $\emptyset$ statistic for use in the analysis of mutation data from pollen grains (A. Katz, Illinois State University, Normal, 1979, personal communication). The test is based on the binomial expansion and thereby assumes that the distribution and origin of mutant pollen grains are meiotic.

The test is defined as:

$$\phi = \frac{n(M-0.5) - N(m+0.5)}{\sqrt{nN(m+M)}}$$

where

1. m = the observed number of mutant pollen grains in the control group.
2. M = the observed number of mutant pollen grains in the treatment group.
3. n = the estimated number of pollen grains analyzed in the control group.
4. N = the estimated number of pollen grains analyzed in the treatment group.

If a one-tailed test is performed and if the level of significance is set at $P < 0.001$ a mutagenic response is demonstrated if $\phi > 4.42$. The high probability value associated with a positive ϕ test was chosen for this project because the ϕ test does not include clustering induced by premeiotic mutational events of germ line cells, the variance estimate is limited by the expansion of the binomial and no dose response data are available for the assay to provide evidence for a trend. Note that the average mutation rate among gametophytes used in the ϕ test is the weighted average, pw .

Finally a range in which the true mutation rate among gametophytes, u , for each control and treatment population is included on each table describing the WX locus data. The range in which the true mutation rate is assumed to be located is limited by the estimators pw and pu .

RESULTS AND DISCUSSION OF THE MAIZE WAXY LOCUS DATA

The results of the in situ maize wx locus assay are presented in Table 19. Specific data accumulated for a particular pesticide or combination of herbicides can be found in Tables 106 through 147. The in situ tests encompassed three years because it was necessary to reevaluate some pesticides or combinations of herbicides. Since the in situ plots were constructed in the field the weaker inbred W22 homozygous wx-C plants had a lower survival rate than the commercial hybrid plants. Thus, a series of tests were needed in order to obtain a reasonable comparison between control and specific treatment populations.

Three descriptive statistical parameters were used to determine if a pesticide elicited a positive response. For each pesticide or combination of pesticides the appropriate estimator of the induced mutation rate at the wx locus among gametophytes was compared with a doubling of the appropriate control value. Thus, a twofold increase in the spontaneous mutation rate among gametophytes was considered as one of three indicators of a positive response. The other two measurements were a significant χ^2 test and/or a t-test when the appropriate data from a control distribution and an independent treatment distribution were compared. For a pesticide treatment to be considered as positive a twofold increase over the estimated spontaneous mutation rate among gametophytes or a significant χ^2 test was required plus a significant t-test. Two of the three statistical parameters must indicate an increase in the number of mutant pollen grains induced by a pesticide treatment for that treatment to be determined as genotoxic.

The insecticide treatments that were determined to be negative in all three statistical measurements employed with the maize wx locus assay were curacron, terbufos, fonofos, carbofuran, chlorpyrifos, metham, and phorate. Ethoprop, chlordane and heptachlor elicited positive responses.

The herbicides or combinations of herbicides that proved negative were procyazine, bifenox, metolachlor plus dicamba, metolachlor plus procyazine, alachlor plus dicamba, and bifenox plus alachlor. The herbicides that induced a positive response were cyanazine and SD50093 (a field grade formulation of atrazine plus cyanazine). In the 1976 in situ evaluation plots only the s-triazine herbicides mentioned above demonstrated a positive response in all three statistical measurements when compared to the 1976 in situ control values.

A second set of in situ evaluation plots were constructed in 1977. The herbicides or combinations of herbicides that were negative were metolachlor, eradican, alachlor, butylate, metolachlor plus dicamba, propachlor plus cyanazine, and butylate plus cyanazine. The herbicides or combinations of herbicides that induced a positive response were

atrazine, cyanazine, SD50093, simazine, metolachlor plus atrazine, metolachlor plus cyanazine, eradican plus cyanazine, eradican plus atrazine, and butylate plus atrazine. Note that all positive cases comprised s-triazine herbicides when used alone or in conjunction with another herbicide.

The final set of in situ evaluation plots were constructed in 1978. Only dicamba and propachlor were tested. When compared to the 1978 control values these herbicides were found not to be mutagenic.

PROJECT DISCUSSION

This project involved the analysis of ten insecticides, eleven herbicides and twelve combinations of herbicides used in commercial corn production in the United States (Table 2). The genotoxic properties of the pesticides were evaluated by using three genetic indicator organisms; point mutation in *S. typhimurium*, gene conversion in *S. cerevisiae* and point mutation in *Z. mays*. The novel features of this project are: 1) The pesticides are related by their use in the production of a major agricultural commodity 2) A broad spectrum of genetic events were measured among a phylogenetically diverse group of genetic indicator organisms 3) Direct, S-9 mammalian microsomal activation and *in vivo* plant activation protocols were employed and 4) the pesticides were evaluated under laboratory and *in situ* conditions. The research conducted in this project provided the first attempt to evaluate agricultural chemicals under modern agricultural conditions.

This project was divided into two options. Option one consisted of the analysis of ten insecticides, nine herbicides and six combinations of herbicides. The pesticides studied in option one were subjected to the entire battery of genetic assays. Option two consisted of two herbicides and six combinations of herbicides which were evaluated by the *in situ* maize *wx* locus assay. The second option was initiated to further study the genotoxic properties of s-triazine herbicides.

The results of this project are presented in Table 1. Of the ten insecticides evaluated, curacron, carbofuran, chlorpyrifos, metham and phorate were negative. Terbufos and ethoprop were positive in one assay. Chlordane, fonofos and heptachlor were positive in two genetic assays. Of the 11 herbicides evaluated, eradican and bifenox were negative in all assays. Alachlor, propachlor, procyazine, atrazine, simazine and SD50093 were positive in one assay. Cyanazine, dicamba and metolachlor were positive in two assays.

REFERENCES

1. Ames, B. N., J. McCann and E. Yamasaki. 1975. Methods for detecting carcinogens and mutagens with the Salmonella mammalian-microsome mutagenicity test. *Mutation Res.* 31:347-364.
2. Bianchi, A. and C. Tomassini. 1965. Reversion frequency of waxy pollen type in normal and hypoploid maize plants. *Mutation Res.* 2:352-365.
3. Briggs, R. W. and H. H. Smith. 1965. Effects of X-radiation on intracistron recombination at the waxy locus in maize. *J. Heredity* 56:157-162.
4. Carlson, W. R., The cytogenetics of corn, in G. F. Sprague (ed.) *Corn and Corn Improvement*, Am. Soc. Agron. Inc., Madison WI 1977. pp225-304.
5. Coe, E. H. and M. G. Neuffer. The genetics of corn, in G. F. Sprague (ed.) *Corn and Corn Improvement*, Am. Soc. Agron. Inc., Madison, WI 1977 pp. 111-223.
6. Collins, G. N. 1909. A new type of Indian corn from China. *Bureau of Plant Indus. U. S. Dept. Bull.* 161.
7. Collins, G. N. and J. H. Kempton. 1909. Inheritance of waxy endosperm in hybrids of Chinese maize. *Bull. Bureau Plant Indus. U. S. Dept. Agric.* 161:547-556.
8. de Serres, F. J. and M. D. Shelby. 1979. The Salmonella mutagenicity assay: recommendations. *Science* 203:563-565.
9. Engels, W. R. 1979. The estimation of mutation rates when premeiotic events are involved. *Environ. Mutagenesis* 1:37-43.
10. Eriksson, G. 1963. Induction of waxy mutants in maize by acute and chronic gamma irradiation. *Hereditas* 50:161-178.
11. Eriksson, G. 1969. The waxy character. *Hereditas* 63:180-204.
12. Eriksson, G. 1971. Variation in radiosensitivity and the dose effect relationship in the low dose region. *Hereditas* 68:101-114.
13. Eriksson, G. and E. Tavrín. 1965. Variations in radiosensitivity during meiosis of pollen mother cells in maize. *Hereditas* 54:156-169.

14. Jiler, H., ed. Commodity Year Book 1978. Commodity Research Bureau, Inc., New York, 1978.
15. Katz, A. J. 1978. Design and analysis of experiments on mutagenicity I. minimal sample sizes. Mutation Res. 50:301-307.
16. Katz, A. J. 1979. Design and analysis of experiments on mutagenicity II. Assays involving microorganisms. Mutation Res. 64:61-77.
17. Nettancourt, D. D., G. Eriksson, D. Lindgren and K. Puite. 1977. Effects of low doses by different types of radiation on the waxy locus using barley and maize. Hereditas 85:89-100.
18. Neuffer, M. G., L. Jones and M. S. Zuber. 1968. The Mutants of Maize. Crop Science Soc. Am. Madison, WI 74 pp.
19. Sprague, G. F., B. Brimhall and R. M. Hixon. 1943. Some effects of the waxy gene in corn on properties of the endosperm starch. J. Am. Soc. Agron. 35:817-822.
20. Watts, R. R., Analytical Reference Standards and Supplemental Data for Pesticides and Other Organic Compounds. Health Effects Research Laboratory, U. S. Environmental Protection Agency (EPA-600/2-81-011), Research Triangle Park, NC (1980) 182 p.
21. Weatherwax, P. 1922. A rare carbohydrate in waxy maize. Genetics 7:568-572.
22. Zimmermann, F. K. 1975. Procedures used in the induction of mitotic recombination and mutation in the yeast Saccharomyces cerevisiae. Mutation Res. 31:71-86.

TABLE 3. STATISTICAL ANALYSIS OF INSECTICIDE DATA USING A DOUBLING RESPONSE (2X) AS AN INDEX OF SIGNIFICANCE

Compound	Activation ^b		Reversion Test <i>S. typhimurium</i>				Conversion Test <i>S. cerevisiae</i>	
	S-9	IS	TA1535	TA1537	TA1538	TA98	TA100	ADE-2 TRP-5
Curacron (C) ^a	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	+(3.4x) ^c	-	-
Curacron (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Chlordane (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	+(2.5x)	+(2.9x)
	-	+	-	-	-	-	-	-
Chlordane (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	+(2.3x)
	-	+	-	-	-	-	+(2.4x)	+(2.1x)
Terbufos (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Terbufos (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	+(8.2x)
	-	+	-	-	-	-	-	+(5.1x)
Fonofos (C)	-	-	-	-	-	-	-	-
	+	-	+(5.4x)	-	-	-	-	+(3.1x)
	-	+	-	+(2.3x)	+(3.2x)	-	+(2.13x)	-
Fonofos (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	+(4.9x)
	-	+	-	-	+(2.5x)	-	-	+(2.5x)
Carbofuran (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-

Compound	Activation ^b		Reversion Test S. typhimurium				Conversion Test A. cerevisiae	
	S-9	IS	TA1535	TA1537	TA1538	TA98	ADE-2	TRP-5
Carbofuran (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Heptachlor (C)	-	-	-	-	-	-	-	-
	+	-	-	+(3.0x)	-	-	-	-
	-	+	-	-	-	-	-	-
Heptachlor (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	+(2.17x)	-	-	+(2.25x)	-	-
Chlorpyrifos (C)	-	-	-	-	-	-	-	-
	+	-	-	+(3.0x)	-	-	-	-
	-	+	-	-	-	-	-	-
Chlorpyrifos (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Metham (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Metham (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Phorate (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Phorate (T)	-	-	-	-	-	-	+(2.2x)	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-

^aC = commercial grade, T = technical grade
^bLiver (S9) or Plant (IS) activation
^cIncrease over control

TABLE 4. STATISTICAL ANALYSIS OF INSECTICIDE DATA USING
THE θ AND ϕ STATISTICAL ANALYSIS AS DESCRIBED BY KATZ (1978; 1979)

Compound	Activation ^b		Reversion Test <i>S. typhimurium</i>				Conversion Test <i>S. cerevisiae</i>	
	S-9	IS	TA1535	TA1537	TA1538	TA98	TA100	ADE-2 TRP-5
Curacron (C) ^a	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	+ θ =2.1 ^c		-	-	-
Curacron (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Chlordane (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	+ ϕ =4 ^c + ϕ =3.3
Chlordane (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	+ ϕ =2.1
	-	+	-	-	-	-	-	+ ϕ =2.1
Terbufos (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Terbufos (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	+ ϕ =25.5 + ϕ =4.6
	-	+	-	-	-	-	-	-
Fonofos (C)	-	-	-	-	-	-	-	-
	+	+ θ =9.1	-	-	-	-	-	+ ϕ =3.4
	-	-	-	+ θ =3	+ θ =3.2	+ θ =9.6	+ ϕ =3	-
Fonofos (T)	-	-	-	-	-	-	-	-
	+	-	-	+ θ =2.8	-	-	+ ϕ =9.8 + ϕ =3.1	+ ϕ =19.4
	-	+	-	-	-	-	-	-
Carbofuran (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-

Compound	Activation ^b		Reversion Test <i>S. typhimurium</i>				Conversion Test <i>S. cerevisiae</i>	
	S-9	IS	TA1535	TA1537	TA1538	TA98	ADP-2	TRP-5
Carbofuran (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Heptachlor (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Heptachlor (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	+ $\theta=3.3$	-	+ $\theta=3.5$ + $\theta=3.2$	+ $\theta=6.5$ + $\theta=4.9$	-	-
Chlorpyrifos (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Chlorpyrifos (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	+ $\theta=6.6$	-	-	-
Metham (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Metham (T)	+	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Phorate (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Phorate (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-

^aC = commercial grade; T = technical grade

^bLiver (S9) or Plant (IS) activation

^c θ or ϕ as calculated by Katz equations. The greatest concentration of chemical in the dose-dependent response curve was used as a basis for comparison with control for the calculation of θ or ϕ .

TABLE 5. STATISTICAL ANALYSIS OF INSECTICIDE DATA USING A DOSE RESPONSE AS A MEASURE OF SIGNIFICANCE

Compound	Activation ^b		Reversion Test <i>S. typhimurium</i>					Conversion Test <i>S. cerevisiae</i>		
	S-9	IS	TA1535	TA1537			TA98	TA100	ADE-2	TRP-5
				TA1537	TA1538	TA1539				
Curacron (C) ^a	-	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-	-
Curacron (T)	-	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-	-
Chlordane (C)	-	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-	+
	-	+	-	-	-	-	-	-	-	+
Chlordane (T)	-	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-	+
	-	+	-	-	-	-	-	-	-	-
Terbufos (C)	-	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-	+
	-	+	-	-	-	-	-	-	-	-
Terbufos (T)	-	-	-	-	-	-	-	-	+	-
	+	-	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-	-
Fonofos (C)	-	-	-	-	-	-	-	-	-	-
	+	-	+	-	-	-	-	+	-	+
	-	+	-	-	-	-	-	-	-	-
Fonofos (T)	-	-	-	-	-	-	-	-	+	-
	+	-	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-	-
Carbofuran (C)	-	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-	-

Compound	Activation ^b		Reversion Test S. typhimurium				Conversion Test S. cerevisiae	
	S-9	IS	TA1535	TA1537	TA1538	TA98	TA100	ADE-2 TRP-5
Carbofuran (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Heptachlor (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Heptachlor (T)	-	-	-	-	-	-	-	-
	+	-	-	-	+	+	+	+
	-	+	+	-	-	-	-	-
Chlorpyrifos (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Chlorpyrifos (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Metham (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Metham (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Phorate (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Phorate (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-

^aC = commercial grade; T = technical grade

^bLiver (S9) or Plant (IS) activation

BP0A7-8

TABLE 6. STATISTICAL ANALYSIS OF HERBICIDE DATA USING A DOUBLING
RESPONSE (2X) AS INDEX OF SIGNIFICANCE

Compound	Activation S-9	b IS	Reversion Test <i>S. typhimurium</i>				Conversion Test <i>S. cerevisiae</i>	
			TA1535	TA1537	TA1538	TA98	TA100	TRP-5
Alachlor (C)	-	-	-	-	-	-	-	+(2.6x) ^c
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Alachlor (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	+(6.1x)	+(2.7x)
Cyanazine (C)	-	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
	-	+	+(2.2x)	+(2.5x)	-	+(2.6x)	-	-
Cyanazine (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	+(5.5x)	+(2.2x)	+(2.1x)	+(2.7x)	-	-
Dicamba (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	+(2.4x)	-	-
	-	+	-	-	-	-	-	-
Dicamba (T)	-	-	+(4.6x)	-	-	-	-	-
	+	-	-	-	-	-	-	+(2.7x)
	-	+	+(3x)	+(3.5x)	-	+(2.9x)	-	-
Procyazine (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-

Compound	Activation ^b		Reversion Test <i>S. typhimurium</i>				Conversion Test <i>S. cerevisiae</i>	
	S-9	IS	TA1535	TA1537	TA1538	TA98	TA100	ADE-2 TRP-5
Procyazine (T)	-	-	-	-	-	-	-	-
	+	-	+(2.5x)	-	-	-	-	+(3.7x)
	-	+	+(5.1x)	+(2x)	+(2.5x)	+(3.5x)	+(2.3x)	+(2.4x)
Metolachlor (C)	-	-	-	-	+(2.x)	+(2.2x)	+(2.4x)	-
	+	-	-	-	+(2.x)	+(2.2x)	+(2.4x)	-
	-	+	-	-	-	-	+(4.3x)	+(2.1x)
Metolachlor (T)	-	-	-	-	+(2.x)	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Eradicane (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	+(3.3x)
Eradicane (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Propachlor (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	+(3.5x)	+(3.1x)
Propachlor (T)	-	-	-	-	-	-	+(6.x)	-
	+	-	-	-	-	-	+(2.1x)	+(3.x)
	-	+	-	-	-	-	-	-
Bifenox (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Bifenox (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-

Compound	Activation ^b		Reversion Test S. typhimurium				Conversion Test S. cerevisiae	
	S-9	IS	TA1535	TA1537	TA1538	TA98	ADE-2	TRP-5
SD50093 (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
SD50093 (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-

^aC = commercial grade; T = technical grade

^bLiver (S9) or Plant (IS) activation

^cIncrease over control

TABLE 7. STATISTICAL ANALYSIS OF HERBICIDE DATA USING THE θ AND ϕ
STATISTICAL ANALYSIS AS DESCRIBED BY KATZ (1978; 1979)

Compound	Activation ^b		Reversion Test <i>S. typhimurium</i>					Conversion Test <i>S. cerevisiae</i>	
	S-9	IS	TA1535	TA1537	TA1538	TA98	TA100	ADE-2	TRP-5
Alachlor (C) ^a	-	-	-	-	-	-	-	+θ=2.1 ^c	+φ=2.5
	+	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-
Alachlor (T)	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-
	-	+	-	+θ=5.1	+θ=2.3 ^c	-	-	+φ=3.1	-
Cyanazine (C)	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-
	-	+	+θ=2.2	+θ=2.7	+θ=2.4	-	-	+φ=2.1	-
Cyanazine (T)	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-
	-	+	-	+θ=5.4	+θ=10.3	-	-	-	-
Dicamba (C)	-	-	-	-	-	-	-	-	-
	+	-	-	-	+θ=4.2	+θ=3.7	-	-	-
	-	+	-	-	-	-	-	-	-
Dicamba (T)	-	+θ=6	-	-	-	-	-	-	-
	+	-	-	-	+θ=2.6	-	-	-	-
	-	+	-	+θ=2.1	+θ=3.9	+θ=9.8	-	-	-
Procyazine (C)	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-

Compound	Activation ^b		Reversion Test <i>S. typhimurium</i>				Conversion Test <i>S. cerevisiae</i>	
	S-9	IS	TA1535	TA1537	TA1538	TA98	ADE-2	TRP-5
Procymazine (T)	-	-	-	-	-	-	-	-
	+	-	+ $\theta=3.6$	-	-	-	-	+ $\theta=4.7$
	-	+	+ $\theta=5.6$	-	+ $\theta=9$	+ $\theta=5.5$	+ $\theta=2.1$	-
Metolachlor (C)	-	-	-	+ $\theta=2.1$	-	-	-	-
	+	-	-	-	-	+ $\theta=6$	+ $\theta=17.6$	+ $\theta=2.7$
	-	+	-	-	-	-	-	-
Metolachlor (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Eradicane (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Eradicane (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Propachlor (C)	-	-	-	-	-	-	+ $\theta=4.1$	-
	+	-	-	-	-	-	+ $\theta=6.9$	+ $\theta=2.7$
	-	+	-	-	-	-	-	-
Propachlor (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	+ $\theta=3.41$
	-	+	-	-	+ $\theta=3.2$	-	+ $\theta=17.2$	+ $\theta=6.1$
Bifenox (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	+ $\theta=4.2$
Bifenox (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-

Compound	Activation ^b		Reversion Test						Conversion Test	
	S-9	IS	S. typhimurium						S. cerevisiae	
			TA1535	TA1537	TA1538	TA98	TA100	ADE-2	TRP-5	
SD50093 (C)	-	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-	-
SD50093 (T)	-	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-	-

^aC = commercial grade; T = technical grade
^bLiver (S9) or Plant (IS) activation
^c0 or 0 as calculated by Katz equations

BP0A12-14

TABLE 8. STATISTICAL ANALYSIS OF HERBICIDE DATA USING A
DOSE RESPONSE AS A MEASURE OF SIGNIFICANCE

Compound	Activation ^b		Reversion Test <i>S. typhimurium</i>				Conversion Test <i>S. cerevisiae</i>	
	S-9	IS	TA1535	TA1537	TA1538	TA98	TA100	ADE-2 TRP-5
Alachlor (C) ^a	-	-	-	-	-	-	-	+
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Alachlor (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	+
Cyanazine (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	-	-	-	-	-	-	-
Cyanazine (T)	-	-	-	-	-	-	+	-
	+	-	-	-	-	-	-	-
	-	+	-	+	-	+	+	-
Dicamba (C)	-	-	+	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
Dicamba (T)	-	-	+	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	+	-	+	+	-
Procyazine (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-

Compound	Activation ^b		Reversion Test S. typhimurium					Conversion Test S. cerevisiae	
	S-9	IS	TA1535	TA1537	TA1538	TA98	TA100	ADE-2	TRP-5
Procyazine (T)	-	-	-	-	-	+	-	-	-
	+	-	+	+	-	-	-	-	-
	-	+	+	-	+	+	+	-	-
Metolachlor (C)	-	-	-	-	-	-	+	-	-
	+	-	-	+	+	-	+	+	+
	-	+	-	-	-	-	-	-	-
Metolachlor (T)	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-
Eradicane (C)	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-
Eradicane (T)	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-
Propachlor (C)	-	-	-	-	-	-	-	-	-
	+	-	+	-	-	-	-	+	+
	-	+	-	-	-	-	-	-	-
Propachlor (T)	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	+	-
	-	+	-	-	-	-	-	-	-
Bifenox (C)	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-
Bifenox (T)	-	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-	-

Compound	Activation ^b		Reversion Test <i>S. typhimurium</i>				Conversion Test <i>S. cerevisiae</i>	
	S-9	IS	TA1535	TA1537	TA1538	TA98	TA100	TRP-5
SD50093 (C)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-
SD50093 (T)	-	-	-	-	-	-	-	-
	+	-	-	-	-	-	-	-
	-	+	-	-	-	-	-	-

^aC = commercial grade; T = technical grade
^bLiver (S9) or Plant (IS) activation

BP0A15-17

TABLE 9. STATISTICAL ANALYSIS OF HERBICIDE COMBINATION DATA
USING A DOUBLING (2X) AS A MEASURE OF SIGNIFICANCE

Compound	Grade	Activation ^b		Reversion Test S. typhimurium				Conversion Test S. cerevisiae	
		S9	IS	TA1535	TA1537	TA1538	TA98	TA100	ADE-2 TRP-5
Procyazine/ Metolachlor	T/T ^a	-	+						-
Alachlor/ Bifenox	C/C	-	+	-	-	-	-	+(2.2x) ^c	-
Cyanazine/ Propachlor	C/C	-	+	-	-	+(33.3x)	+(7.1x)	-	+(6.9x)
Metolachlor/ Atrazine	C/C	-	+	-	-	-	+(2x)	-	-
Cyanazine/ Alachlor	C/C	-	+	+(9.1x)	-	-	-	-	-
Alachlor/ Dicamba	C/C	-	+	-	-	-	-	-	-
Procyazine/ Metolachlor	C/C	-	+	-	-	-	-	+(2.2x)	-
Metolachlor/ Dicamba	T/T	-	+	-	-	-	-	+(2.2x)	+(8x)

^aC = commercial grade; T = technical grade

^bLiver (S9) or Plant (IS) activation

^cIncrease over control

TABLE 10. STATISTICAL ANALYSIS OF HERBICIDE COMBINATION
DATA USING THE θ AND ϕ ANALYSIS AS DESCRIBED BY KATZ (1978; 1979)

Compound	Grade	Activation ^b		Reversion Test				Conversion Test	
		S9	1S	TA1535	TA1537	TA1538	TA98	TA100	S. cerevisiae ADE-2 TRP-5
Procyazine/ Metolachlor	T/T ^a	-	+	-	-	-	-	-	-
Alachlor/ Bifenox	C/C	-	+	-	-	-	-	+ θ =1.9 ^c	-
Cyanazine/ Propachlor	C/C	-	+	-	-	+ θ =19.7	+ θ =11.3	-	+ ϕ =4.7
Metolachlor/ Atrazine	C/C	-	+	-	-	-	+ θ =2.1	-	-
Cyanazine/ Alachlor	C/C	-	+	+ θ =4.7	-	-	-	-	-
Alachlor/ Dicamba	C/C	-	+	-	-	-	-	-	-
Procyazine/ Metolachlor	C/C	-	+	-	-	-	-	+ θ =2.2	-
Metolachlor/ Dicamba	T/T	-	+	-	-	-	-	-	+ ϕ =4.6

^aC = commercial grade; T = technical grade

^bLiver (S9) or Plant (1S) activation

^c θ or ϕ as calculated by Katz equations

TABLE 11. STATISTICAL ANALYSIS OF HERBICIDE COMBINATIONS DATA
USING A DOSE RESPONSE AS A MEASURE OF SIGNIFICANCE

Compound	Grade	Activation ^b		Reversion Test S. typhimurium				Conversion Test S. cerevisiae	
		S9	IS	TA1535	TA1537	TA1538	TA98	TA100	ADE-2 TRP-5
Procyazine/ Metolachlor	T/T ^a	-	+						-
Alachlor/ Bifenox	C/C	-	+	-	-	-	+	+	-
Cyanazine/ Propachlor	C/C	-	+	-	-	+	+	-	-
Metolachlor/ Atrazine	C/C	-	+	-	-	-	+	+	-
Cyanazine/ Alachlor	C/C	-	+	+	-	-	-	+	-
Alachlor/ Dicamba	C/C	-	+	-	-	-	-	-	-
Procyazine/ Metolachlor	C/C	-	+	-	-	-	+	-	+
Metolachlor/ Dicamba	T/T	-	+	-	-	-	-	-	+

^aC = commercial grade; T = technical grade

^bLiver (S9) or Plant (IS) activation

TABLE 12. SUMMARY OF STATISTICAL ANALYSIS OF MICROBIAL DATA
FOR INSECTICIDES: DIRECT ASSAYS

Compound	Grade ^a	<u>S. typhimurium^b Assay</u>			<u>S. cerevisiae Assay^c</u>		
		θ	2X	Dose Response	ϕ	2X	Dose Response
Curacron	C	-	-	-	-	-	-
Curacron	T	-	-	-	-	-	-
Chlordane	C	-	-	-	-	+(2)	-
Chlordane	T	+(1)	-	-	-	-	-
Terbufos	C	-	-	-	-	+(2)	+(1)
Terbufos	T	-	-	-	+(1)	+(1)	+(1)
Fonofos	C	-	-	-	+(1)	+(1)	-
Fonofos	T	-	-	-	+(2)	-	+(1)
Carbofuran	C	-	-	-	-	-	-
Carbofuran	T	-	-	-	-	-	-

Compound	Grade ^a	S. typhimurium ^b Assay		S. cerevisiae Assay ^c	
		θ	2X Dose Response	∅	2X Dose Response
Heptachlor	C	-	-	-	-
Heptachlor	T	-	-	-	-
Chlorpyrifos	C	-	-	-	-
Chlorpyrifos	T	-	-	-	-
Metham	C	-	-	-	-
Metham	T	-	-	-	-
Phorate	C	-	-	-	-
Phorate	T	-	-	-	+(1)

^aC = commercial grade, T = technical grade

^ba - sign indicates a negative response

^ca + sign indicates a positive response

^dindicates the number of strains where a positive response was found

^eindicates the number of loci where a positive response was found

BP0A21-22

TABLE 13. SUMMARY OF STATISTICAL ANALYSIS OF MICROBIAL DATA
FOR INSECTICIDES: MAMMALIAN ACTIVATION STUDIES

Compound	Grade ^a	<u>S. typhimurium^b Assay</u>			<u>S. cerevisiae Assay^c</u>		
		θ	2X	Dose Response	ϕ	2X	Dose Response
Curacron	C	-	-	-	-	-	-
Curacron	T	-	-	-	-	-	-
Chlordane	C	-	-	-	+(2)	+(2)	+(1)
Chlordane	T	+(1)	-	-	+(1)	+(1)	+(1)
Terbufos	C	-	-	-	-	-	-
Terbufos	T	-	-	-	+(1)	+(1)	+(1)
Fonofos	C	+(4)	+(3)	+(4)	+(1)	-	-
Fonofos	T	+(1)	+(1)	+(1)	+(1)	+(1)	-
Carbofuran	C	-	-	-	-	-	-
Carbofuran	T	-	-	-	-	-	-

Compound	Grade ^a	<u>S. typhimurium</u> ^b Assay		<u>S. cerevisiae</u> Assay ^c	
		θ	2X Dose Response	Ø	2X Dose Response
Heptachlor	C	-	+(1)	-	-
Heptachlor	T	+(2)	+(1)	-	+(1)
Chlorpyrifos	C	-	+(1)	-	-
Chlorpyrifos	T	-	-	-	-
Metham	C	-	-	-	-
52 Metham	T	-	-	-	-
Phorate	C	-	-	-	-
Phorate	T	-	-	-	+(1)

^aC = commercial grade, T = technical grade

^ba - sign indicates a negative response

^ca + sign indicates a positive response

^dindicates the number of strains where a positive response was found

^eindicates the number of loci where a positive response was found

TABLE 14. SUMMARY OF STATISTICAL ANALYSIS OF MICROBIAL DATA
FOR INSECTICIDES: PLANT ACTIVATION STUDIES

Compound	Grade ^a	<u>S. typhimurium^b Assay</u>		<u>S. cerevisiae Assay^c</u>	
		θ	2X Dose Response	ϕ	2X Dose Response
Curacron	C	+(1)	+(1)	-	-
Curacron	T	-	-	-	-
Chlordane	C	-	-	+(2)	+(1)
Chlordane	T	-	-	+(1)	-
Terbufos	C	-	-	-	-
Terbufos	T	-	-	-	-
Fonofos	C	-	+(1)	-	-
Fonofos	T	-	-	-	-
Carbofuran	C	-	-	-	-
Carbofuran	T	-	-	-	-

Compound	Grade ^a	S. typhimurium ^b Assay			S. cerevisiae Assay ^c		
		Ø	2X	Dose Response	Ø	2X	Dose Response
Heptachlor	C	-	-	-	-	-	-
Heptachlor	T	+(3)	+(1)	+(1)	-	-	-
Chlorpyrifos	C	-	-	-	-	-	-
Chlorpyrifos	T	+(1)	-	-	-	-	-
Metham	C	-	-	-	-	-	-
Metham	T	-	-	-	-	-	-
Phorate	C	-	-	-	-	-	-
Phorate	T	-	-	-	-	+(1)	-

^a C = commercial grade, T = technical grade

^b - sign indicates a negative response

^c + sign indicates a positive response

^d indicates the number of strains where a positive response was found

^e indicates the number of loci where a positive response was found

TABLE 15. SUMMARY OF STATISTICAL ANALYSIS OF MICROBIAL DATA
FOR HERBICIDES: DIRECT ASSAYS

Compound	Grade ^a	<u>S. typhimurium</u> ^b Assay		<u>S. cerevisiae</u> ^c Assay	
		Ø	2X Dose Response	Ø	2X Dose Response
Alachlor	C	-	-	+(2)	+(2)
Alachlor	T	-	-	-	-
Cyanazine	C	-	-	-	-
Cyanazine	T	-	+(1)	-	-
Dicamba	C	+(1)	+(1)	-	-
Dicamba	T	+(1)	+(1)	-	-
Procyazine	C	-	-	-	-
Procyazine	T	-	+(1)	-	+(1)
Metolachlor	C	+(1)	+(1)	+(2)	-
Metolachlor	T	-	+(1)	-	-

Compound	Grade ^a	S. typhimurium ^b Assay			S. cerevisiae Assay ^c		
		θ	2X	Dose Response	φ	2X	Dose Response
Eradicane	C	-	+(1)	-	-	-	-
Eradicane	T	-	-	-	-	+(1)	-
Propachlor	C	-	-	+(1)	-	-	-
Propachlor	T	-	-	-	+(1)	+(2)	-
Bifenox	C	-	-	-	-	-	-
Bifenox	T	-	-	-	-	-	-
SD50093	C	-	-	-	-	-	-
SD50093	T	-	-	-	-	-	-

^aC = commercial grade, T = technical grade

^ba - sign indicates a negative response

^ca + sign indicates a positive response

^dindicates the number of strains where a positive response was found

^eindicates the number of loci where a positive response was found

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TABLE 16. SUMMARY OF STATISTICAL ANALYSIS OF MICROBIAL DATA
FOR HERBICIDES: MAMMALIAN ACTIVATION

Compound	Grade ^a	<u>S. typhimurium</u> ^b Assay		<u>S. cerevisiae</u> ^c Assay	
		θ	2X Dose Response	φ	2X Dose Response
Alachlor	C	-	-	-	-
Alachlor	T	-	-	-	-
Cyanazine	C	-	-	-	-
Cyanazine	T	-	-	-	-
Dicamba	C	+(2)	+(1)	-	+(1)
Dicamba	T	+(1)	-	+(1)	+(1)
Procyazine	C	-	-	-	-
Procyazine	T	+(1)	+(1)	+(1)	-
Metolachlor	C	+(1)	+(3)	+(2)	+(1)
Metolachlor	T	-	-	-	-

Compound	Grade ^a	S. typhimurium ^b Assay		S. cerevisiae Assay ^c	
		Ø	2X Dose Response	Ø	2X Dose Response
Eradicane	C	-	-	-	-
Eradicane	T	-	-	-	-
Propachlor	C	-	-	+(1)	+(1)
Propachlor	T	-	-	+(1)	+(1)
Bifenox	C	-	-	-	-
Bifenox	T	-	-	-	-
SD50093	C	-	-	+	+
SD50093	T	-	-	-	-

^aC = commercial grade, T = technical grade

^ba - sign indicates a negative response

^ca + sign indicates a positive response

^dindicates the number of strains where a positive response was found

^eindicates the number of loci where a positive response was found

BP0A29-30

TABLE 17. SUMMARY OF STATISTICAL ANALYSIS OF MICROBIAL DATA
FOR HERBICIDES: PLANT ACTIVATION STUDIES

Compound	Grade ^a	S. typhimurium ^b Assay			S. cerevisiae Assay ^c		
		θ	2X	Dose Response	φ	2X	Dose Response
Alachlor	C	-	-	-	-	-	-
Alachlor	T	+(2)	-	-	+(2)	+(2)	+(1)
Cyanazine	C	+(4)	+(3)	+(5)	+(1)	-	+(1)
Cyanazine	T	+(3)	+(4)	+(3)			
Dicamba	C	-	-	-			
Dicamba	T	+(3)	+(2)	+(3)			
Procyazine	C						
Procyazine	T	+(3)	+(5)	+(3)	+(1)	-	-
Metolachlor	C	-	-	-	-	+(1)	-
Metolachlor	T	-	-	-	+(1)	-	-

Compound	Grade ^a	S. typhimurium ^b Assay		S. cerevisiae Assay ^c	
		θ	2X Dose Response	φ	2X Dose Response
Eradicane	C	-	-	-	+(1) -
Eradicane	T	-	-	-	- -
Propachlor	C	-	-	+(2)	+(1) +(2)
Propachlor	T	+(1)	-	+(2)	+(2) +(7)
Bifenox	C	-	-	+(1)	- -
Bifenox	T	-	-	-	- -
SD50093	C				
SD50093	T				

^aC = commercial grade, T = technical grade

^ba - sign indicates a negative response

^ca + sign indicates a positive response

^dindicates the number of strains where a positive response was found

^eindicates the number of loci where a positive response was found

BP0A31-32

TABLE 18. SUMMARY OF STATISTICAL ANALYSIS OF HERBICIDE COMBINATIONS:
PLANT ACTIVATION STUDIES

Compound	Grade ^a	<u>S. typhimurium^b Assay</u>		<u>S. cerevisiae Assay^c</u>	
		θ	2X Dose Response	ϕ	2X Dose Response
Bladex/Aroclor	C/C	+(1)	+(1)	-	-
Alachlor/Banvel	C/C	+(1)	+(1)	-	-
Bladex/Propachlor	C/C	+(2)	+(2)	+(1)	+(1)
Dual/Banvel	T/T	-	-	+(1)	+(2)
Cycle/Dual	C/C	-	-	+(1)	+(1)
Dual/Atrazine	C/C	+(1)	+(1)	+(2)	-
Alachlor/Modown	C/C	+(1)	+(1)	+(2)	-

^aC = commercial grade, T = technical grade

^b- sign indicates a negative response

^c+ sign indicates a positive response

^dindicates the number of strains where a positive response

^eindicates the number of loci where a positive response was found

TABLE 19
Maize Summary Table

Treatment Group	Estimated u (x10 ⁻⁵)	Statistical Evaluation		
		2X Control	t	φ
Insecticides 1976				
Control	3.97	NA	NA	NA
Curacron	6.73	-	-	-
Chlordane	9.72	+	+	+
Terbufos	7.30	-	-	-
Fonofos	6.14	-	-	-
Carbofuran	6.15	-	-	-
Heptachlor	10.40	+	+	+
Chlorpyrifos	2.74	-	-	-
Ethoprop	7.92	-	+	+
Metham	6.85	-	-	-
Phorate	4.08	-	-	-

Herbicides 1976

Control	5.28	NA	NA	NA
Cyanazine	28.25	+	+	+
Procyazine	4.65	-	-	-
Bifenox	9.05	-	+	-
SD50093	39.37	+	+	+
Metolachlor + Dicamba	8.22	-	+	-
Metolachlor + Procyazine	9.84	-	+	-
Alachlor + Dicamba	3.82	-	-	-
Bifenox + Alchlor	6.96	-	-	-
Bifenox + Alachlor	4.29	-	-	-

Herbicides 1977

Control	4.24	NA	NA	NA
Atrazine	8.53	+	+	+
Cyanazine	14.76	+	+	+
Metolachlor	2.84	-	-	-
Metolachlor	4.06	-	-	-
Eradicane (EPTC)	4.33	-	-	-
Alachlor	4.21	-	-	-
SD50093	16.25	+	+	+

Simazine	10.86	+	+	+
Butylate	5.28	-	-	-
Metolachlor + Atrazine	12.27	+	+	+
Metolachlor + Dicamba	7.31	-	+	-
Metolachlor + Cyanazine	10.84	+	+	+
Eradicane + Atrazine	14.20	+	+	+
Eradicane + Cyanazine	8.61	+	+	+
Propachlor + Cyanazine	6.29	-	-	-
Butylate + Atrazine	8.25	-	+	+
Butylate + Cyanazine	5.89	-	-	-

Herbicides 1978

Control	2.91	NA	NA	NA
Dicamba	2.44	-	-	-
Propachlor	3.20	-	-	-

TABLE 20

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
				TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		84	121	10	16	18
	+	-		112	96	18	24	25
	-	+		162	150	9	18	7
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	-				
	-	+	30	-				
Positive Control, AFB ₁	-	-	1		87			
	+	-	1		357			
	-	+	1		-			
Curacron, Commercial	-	-	.1	88	99	7	19	27
	-	-	1	113	111	11	24	35
	-	-	10	82	110	10	16	19
	+	-	.1	112	120	6	29	33
	+	-	1	92	135	28	23	63
	+	-	10	80	111	23	20	58
	-	+	I ^a	140	115	8	23	14
	-	+	I ^b	150	129	8	14	5
	-	+	I ^c	142	125	5	3	24

I. *Z. mays* plants were treated with 3.7 mg/pot (I^a), 17.5 mg/pot (I^b), and 33.7 mg/pot (I^c) of the compound.
Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A26

TABLE 21

IN VITRO ASSAYS WITH *SALMONELLA TYPHIMURIUM*

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		112	107			
	+	-		127	89			
	-	+		145	143	7	25	10
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	-				
	-	+	30	>20,000				
Curacron, Technical	-	-	.1	97	86			
	-	-	.1	106	98			
	-	-	10	121	100			
	+	-		117	93			
	+	-		126	104			
	+	-		103	82			
	-	+	I ^a	105	111	8	31	3
	-	+	I ^b	80	131	8	26	7
	-	+	I ^c	112	94	3	24	11

I. *Z. mays* plants were treated with 10 mg/pot (I^a), 20 mg/pot (I^b), and 40 mg/pot (I^c) of the compound.
Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A25

TABLE 22
IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	1S		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		137	102	1	10	18
	+	-		141	135	10	22	12
	-	+		153	151	3	7	6
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	-				
	-	+	20	>20,000				
Positive Control, AFB ₁	-	-	1		97			
	+	-	1		273			
	-	+	1		-			
Chlordane, Commercial	-	-	.1	125	94	0	17	17
	-	-	1	116	92	3	12	14
	-	-	10	109	114	2	12	13
	+	-	.1	132	90	8	8	6
	+	-	1	141	121	4	9	4
	+	-	10	121	101	9	38	20
	-	+	1 ^a	148	176	3	7	8
	-	+	1 ^b	139	174	4	7	7
	-	+	1 ^c	128	147	3	8	8

I. Z. mayes plants were treated with $6.83 \times 10^{-5} \text{M}(\text{I}^a)$, $2.54 \times 10^{-4} \text{M}(\text{I}^b)$, and $5.34 \times 10^{-4} \text{M}(\text{I}^c)$ of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated 1S was added/plate.

BP10A24

TABLE 23

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	1S		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		140	125	10	26	15
	+	-		150	124	15	22	8
	-	+		189	151	11	14	15
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	403				
	-	+	30	-				
Positive Control, AFB ₁	-	-	1	100				
	+	-	1	276				
	-	+	-	-				
Chlordane, Technical	-	-	.1	131	126	10	28	27
	-	-	1	152	114	9	36	13
	-	-	10	127	156	8	46	7
	+	-	.1	116	154	4	40	8
	+	-	1	147	183	10	37	16
	+	-	10	151	200	8	36	13
	-	+	I ^a	166	100	11	10	13
	-	+	I ^b	107	123	14	11	11
	-	+	I ^c	191	149	12	13	12

I. *Z. mays* plants were treated with $4.75 \times 10^{-6}M$ (I^a), $4.75 \times 10^{-5}M$ (I^b), and $4.75 \times 10^{-4}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated 1S was added/plate.

BP10A23

TABLE 24

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		78	46	10	3	2
	+	-		106	170	20	17	3
	-	+		117	100	18	19	6
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	-				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1	51				
	+	-	1	179				
	-	+	-	-				
Terbufos, Commercial	-	-	.1	53	59	10	5	4
	-	-	1	81	68	9	3	7
	-	-	10	84	47	11	4	3
	+	-	.1	56	117	7	6	2
	+	-	1	78	116	5	11	7
	+	-	10	111	98	3	4	12
	-	+	1 ^a	114	182	27	28	4

I. Z. mays plants were treated with $1.73 \times 10^{-4}M$ (I^a) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A22

TABLE 25

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		118	102	13	8	5
	+	-		130	124	13	18	19
	-	+		125	119	12	15	25
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	-				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1		87			
	+	-	1		282			
	-	+	-		-			
Terbufos, Technical	-	-	.1	102	89	7	4	5
	-	-	1	94	113	12	2	7
	-	-	10	69	105	-	2	8
	+	-	.1	110	94	14	9	17
	+	-	1	87	110	13	8	27
	+	-	10	103	121	18	14	31
	-	+	I ^a	92	98	13	13	20
	-	+	I ^b	105	104	14	17	29

I. Z. mays plants were treated with $7.55 \times 10^{-5}M$ (I^a) and $1.51 \times 10^{-4}M$ (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A21

TABLE 26

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		165	64	33	13	16
	+	-		67	115	5	4	8
	-	+		157	144	10	17	24
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	358				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1		78			
	+	-	1		196			
	-	+	-		-			
Fonofos, Commercial	-	-	.1	151	55	31	11	22
	-	-	1	155	59	34	10	15
	-	-	10	146	55	22	15	17
	+	-	.1	142	120	9	3	17
	+	-	1	143	161	21	5	13
	+	-	10	127	189	27	3	26
	-	+	1 ^a	177	187	10	40	33
	-	+	1 ^b	167	176	11	27	37

I. *Z.* mays plants were treated with 1.5×10^{-4} M (1^a) and 7.71×10^{-4} M (1^b) of the compound.
Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A15

TABLE 27

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		64	65	2	5	7
	+	-		94	91	11	10	13
	-	+		145	143	7	25	10
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	502				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1	-	82			
	+	-	1	-	197			
	-	+	1	-	-			
Fonofos, Technical	-	-	.1	92	52	0	6	4
	-	-	1	69	64	1	5	10
	-	-	10	80	65	3	2	13
	+	-	.1	74	110	10	10	5
	+	-	1	72	91	10	9	21
	+	-	1	91	112	8	11	33
	-	+	1 ^a	118	120	3	18	11
	-	+	1 ^b	127	157	3	25	6
	-	+	1 ^c	86	92	2	30	8

I. Z. mays plants were treated with $1.54 \times 10^{-5}M^a$, $7.7 \times 10^{-5}M^b$, and $1.54 \times 10^{-4}M^c$ of the compound.
Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.
BP10A14

TABLE 28

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	1S		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		96	103		8	14
	+	-		92	97		3	9
	-	+		109	104	10	5	8
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	502				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-		82				
	+	-		197				
	-	+						
Carbofuran, Commercial	-	-	.1	102	121		9	11
	-	-	1	88	104		9	17
	-	-	10	88	104		11	11
	+	-	.1	84	103		1	8
	+	-	1	87	89		2	1
	+	-	10	71	122		4	1
	-	+	1 ^a	76	91	10	-	7
	-	+	1 ^b	102	128	13	6	8
	-	+	1 ^c	121	134	12	8	6
	-	+						
	-	+						
	-	+						

I. Z. mays plants were treated with $5.2 \times 10^{-3}M$ (I^a), $2.85 \times 10^{-3}M$ (I^b), and $5.59 \times 10^{-3}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated 1S was added/plate.

BP10A12

TABLE 29

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	1S		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		60	63	3	2	9
	+	-		61	78	-	3	12
	-	+						
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	631				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1		75			
	+	-	1		186			
	-	+	-		-			
Carbofuran, Technical	-	-		70	70	3	1	7
	-	-		44	53	3	2	9
	-	-		89	49	4	1	7
	+	-		65	84	-	5	15
	+	-		65	91	-	7	14
	+	-		77	122	-	6	9

BP10A11

TABLE 30

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		101	114	6	15	13
	+	-		157	153	11	4	13
	-	+		168	150	10	9	11
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	717				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1		79			
	+	-	1		291			
	-	+	-		-			
Heptachlor, Commercial	-	-	.01	144	84	10	3	10
	-	-	.1	164	89	7	3	11
	-	-	1	73	108	2	15	11
	+	-	.01	135	216	10	4	10
	+	-	.1	201	209	12	5	11
	+	-	1	233	236	15	12	10
	-	+	I ^a	186	92	12	3	9
	-	+	I ^b	309	81	14	2	7
	-	+	I ^c	199	237	11	12	13

I. *Z. mays* plants were treated with $8.85 \times 10^{-5}M$ (I^a), $4.85 \times 10^{-4}M$ (I^b), and $8.98 \times 10^{-4}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A10

TABLE 31

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE			
				TA100	TA98	TA1535	TA1537
Negative Control	-	-		111	87	7	8
	+	-		92	112	2	7
	-	+		188	127	28	15
Positive Control, NG ₁	-	-	30	>20,000			15
	+	-	30	717			9
	-	+	30	>20,000			16
Positive Control, AFB ₁	-	-	-		79		
	+	-	-		241		
	-	+	-				
Heptachlor, Technical	-	-	.1	61	124	10	4
	-	-	.1	85	109	-	7
	-	-	10	86	110	8	6
	+	-	.1	152	107	-	7
	+	-	.1	172	145	1	3
	+	-	10	207	176	4	4
	-	+	I ^a	285	183	37	16
	-	+	I ^b	232	200	52	23
	-	+	I ^c	297	185	61	19
			I				21
							18

I. Z. mays plants were treated with $8.89 \times 10^{-6}M$ (I^a), $8.89 \times 10^{-5}M$ (I^b), and $8.89 \times 10^{-4}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A9

TABLE 32

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	1S		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		125	110	-	5	15
	+	-		78	96	-	4	8
	-	+		206	170	14	17	18
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	-				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-		-				
	+	-		-				
	-	+		-				
Chlorpyrifos, Commercial	-	-	.1	108	129	--	7	20
	-	-	1	173	200	--	4	10
	-	-	10	160	79	--	5	10
	+	-	.1	93	95	--	12	9
	+	-	1	86	105	--	5	15
	+	-	10	64	132	--	6	8
	-	+	I ^a	264	296	10	30	22
	-	+	I ^b	216	192	12	19	31
	-	+	I ^c	257	185	3	23	19
	-	+	I ^c					

I. Z. mays plants were treated with 5 mg/pot (I^a), 19 mg/pot (I^b), and 39 mg/pot (I^c) of the compound.
Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A8

TABLE 33

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		151	95	-	8	13
	+	-		132	98	-	17	-
	-	+		173	209	10	21	29
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	402				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	-	93				
	+	-	-	220				
	-	+	-					
Chlorpyrifos, Technical	-	-	.1	146	114	-	9	7
	-	-	1	127	122	-	10	13
	-	-	10	139	91	-	9	15
	+	-	.1	160	86	-	12	-
	+	-	1	157	122	-	12	-
	+	-	10	112	95	-	20	-
	-	+	I ^a	109	198	11	15	23
	-	+	I ^b	103	416	10	13	19
	-	+	I ^c	121	373	12	18	26
	-	-						
	-	-						

I. *Z. mays* plants were treated with 10 mg/pot (I^a), 20 mg/pot (I^b), and 40 mg/pot (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A7

TABLE 34

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	1S		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		94	111	10	10	10
	+	-		147	144	10	13	12
	-	+		118	104	6	6	9
Positive Control, Ng ₁	-	-	30	>20,000				
	+	-	30	402				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1		99			
	+	-	1		220			
	-	+	1					
Phorate, Commercial	-	-	.1	109	146	10	11	10
	-	-	1	110	134	12	12	12
	-	-	10	94	164	11	11	10
	+	-	.1	148	108	10	11	18
	+	-	1	143	154	-	13	17
	+	-	10	163	170	9	17	21
	-	+	I ^a	181	124	10	14	10
	-	+	I ^b	179	204	13	8	10
	-	+	I ^c	114	131	-	-	4

I. Z. mays plants were treated with $3.1 \times 10^{-4}M$ (I^a), $1.38 \times 10^{-3}M$ (I^b), and $2.75 \times 10^{-3}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated 1S was added/plate.

BP10A6

TABLE 35

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE					
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538	
Negative Control	-	-		143	79	10	6	6	
	+	-		161	92	8	-	6	
	-	+		191	154	14	6	8	
Positive Control, NG	-	-	30	>20,000					
	+	-	30	402					
	-	+	30	>20,000					
Positive Control, AFB ₁	-	-	1		99				
	+	-	1		220				
	-	+	1		-				
Phorate, Technical	-	-	.1	150	69	8	4	4	
	-	-	1	98	103	7	4	2	
	-	-	10	144	110	10	5	5	
	+	-	.1	155	117	9	-	8	
	+	-	1	151	127	5	-	5	
	+	-	10	193	77	8	-	6	
	-	+	I ^a	268	271	11	5	10	
	-	+	I ^b I	313	290	20	8	20	

I. *Z. mays* plants were treated with $3.88 \times 10^{-5}M$ (I^a) and $3.88 \times 10^{-4}M$ (I^b) of the compound.
Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A5

TABLE 36

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE			
				TA100	TA98	TA1535	TA1537 TA1538
Negative Control	-	-		103	74	6	2 3
	+	-		99	87	4	5 4
	-	+		93	104	2	2 3
Positive Control, NG	-	-		>20,000			
	+	-		719			
	-	+		>20,000			
Positive Control, AFB ₁	-	-			89		
	+	-			498		
	-	+					
Metham, Commercial	-	-	.1	113	76	7	3 2
	-	-	1	104	72	3	3 5
	-	-	10	106	41	2	2 3
	+	-	.1	98	88	3	4 3
	+	-	1	137	116	5	2 2
	+	-	10	120	100	7	6 4
	-	+	I ^a	117	153	3	7 2
	-	+	I ^b	70	119	3	6 2
	-	+	I ^c	129	149	1	11 5

I. Z. may's plants were treated with 4.3 mg/pot (I^a), 21.5 mg/pot (I^b), and 42.2 mg/pot (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated or untreated were prepared according to the methods listed in this report, and 3 mg of treated 1S was added/plate.

BP10A90

TABLE 37

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		127	87	6	10	8
	+	-		131	110	7	7	4
	-	+		142	79	8	3	9
Positive Control, NG	-	-		>20,000				
	+	-		719				
	-	+		>20,000				
Positive Control, AFB ₁	-	-						
	+	-			89			
	-	+			498			
Metham, Technical	-	-	.1	131	118	7	9	7
	-	-	1	148	103	5	7	8
	-	-	10	115	112	8	8	15
	+	-	.1	137	111	13	6	3
	+	-	1	129	127	13	5	2
	+	-	10	156	109	12	11	6

BP10A91

TABLE 38

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		110	47	7	3	6
	+	-		112	50	4	2	5
	-	+		140	110	3	7	4
Positive Control, NG	-	-		>20,000				
	+	-		-				
	-	+		-				
Positive Control, AFB ₁	-	-			76			
	+	-			297			
	-	+						
Alachlor, Commercial	-	-	.1	109	48	6	4	3
	-	-	1	112	52	7	3	5
	-	-	10	140	61	4	2	7
	+	-	.1	126	48	5	1	4
	+	-	1	107	37	7	2	2
	+	-	10	98	84	2	3	3
	-	+	1 ^a	157	121	5	10	7

I. *Z. mays* plants were treated with $7.0 \times 10^{-4}M$ (1^a) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated or untreated IS was added/plate.

BP10A91

TABLE 39

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	1S		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		93	73	13	6	13
	+	-		109	89	10	9	15
	-	+		120	93	21	12	11
Positive Control, NG	-	-	30	>20,000				
	+	-	30	417				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1		70			
	+	-	1		257			
	-	+	1					
Alachlor, Technical	-	-	1	92	86	15	6	7
	-	-	10	81	100	10	8	17
	-	-	100	73	97	16	14	20
	+	-	1	103	136	6	6	16
	+	-	10	96	101	9	5	19
	+	-	100	111	139	6	6	16
	-	+	I ^a	106	131	32	7	24
	-	+	I ^b	155	106	38	7	25
	-	+	I ^c	188	163	21	15	16

I. Z. mays plants were treated with $7.0 \times 10^{-5}M$ (I^a), $1.4 \times 10^{-4}M$ (I^b), and $1.4 \times 10^{-3}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated 1S was added/plate.

BP10A2

TABLE 40

IN VITRO ASSAYS WITH *SALMONELLA TYPHIMURIUM*

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		133	103	11	7	17
	+	-		145	101	13	11	20
	-	+		335	180	23	19	21
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	518				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1		85			
	+	-	1		278			
	-	+	1		-			
Cyanazine, Commercial	-	-	1	145	98	10	8	19
	-	-	1	154	111	14	9	21
	-	-	10	166	120	12	3	12
	+	-	1	145	101	13	11	29
	+	-	1	123	111	19	22	30
	+	-	10	147	132	11	18	22
	-	+	I ^a	672	204	37	38	47
	-	+	I ^b	955	227	42	41	52

I. Z. mays plants were treated with $5.17 \times 10^{-4}M$ (I^a) and $5.17 \times 10^{-3}M$ (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A27

TABLE 41

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		64	100	5	6	12
	+	-		68	83	8	3	9
	-	+		140	158	24	10	17
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	518				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1		85			
	+	-	1		278			
	-	+	1		-			
Cyanazine, S ₅ Technical	-	-	.1	92	108	6	6	21
	-	-	1	101	115	2	7	9
	-	-	10	111	118	8	5	16
	+	-	.1	67	73	3	1	13
	+	-	1	69	71	4	2	7
	+	-	10	72	85	5	1	9
	-	+	I ^a	243	277	41	16	30
	-	+	I ^b	254	281	10	37	37
	-	+	I ^c	375	340	21	55	27

I. Z. mays plants were treated with $2.513 \times 10^{-4}M$ (I^a), $2.513 \times 10^{-3}M$ (I^b), and $2.513 \times 10^{-2}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A28

TABLE 42

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE					
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538	
Negative Control	-	-		69	71	40	5	18	
	+	-		76	106	33	7	11	
	-	+		149	154	16	11	7	
Positive Control, NG ₁	-	-	30	>20,000					
	+	-	30	318					
	-	+	30	>20,000					
Positive Control, AFB ₁	-	-	1		70				
	+	-	1		250				
	-	+	1						
Dicamba, Commercial	-	-	.1	44	68	29	9	30	
	-	-	1	58	56	32	5	9	
	-	-	10	76	61	55	5	26	
	+	-	.1	89	170	45	10	13	
	+	-	1	140	198	29	8	13	
	+	-	10	185	132	34	9	11	
	-	+	I ^a	99	130	15	7	9	
	-	+	I ^b	148	150	17	8	7	
			I						

I. *Z. mays* plants were treated with $1.07 \times 10^{-5}M$ (I^a) and $1.07 \times 10^{-4}M$ (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A29

TABLE 43

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		µg COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE			
	S-9	IS		TA100	TA98	TA1535	TA1537 TA1538
Negative Control	-	-		73	43	38	6 4
	+	-		76	58	10	6 12
	-	+		110	61	3	4 4
Positive Control, NG ₁	-	-	30	>20,000			
	+	-	30	400			
	-	+	30	>20,000			
Positive Control, AFB ₁	-	-	1		70		
	+	-	1		250		
	-	+	1				
Dicamba, Technical	-	-	0.1	80	43	114	4 8
	-	-	1	70	46	150	8 5
	-	-	10	76	70	176	7 5
	+	-		66	92	13	3 10
	+	-		71	86	11	3 8
	-	+	I ^a	101	93	3	4 8
	-	+	I ^b	314	114	9	6 14

I. *Z. mays* plants were treated with $2.675 \times 10^{-5}M$ (I^a) and $5.35 \times 10^{-5}M$ (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A30

TABLE 44

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		123	154	21	15	21
	+	-		149	134	7	7	12
	-	+						
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	-				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1		107			
	+	-	1		349			
	-	+	-		-			
Procyzazine, Commercial	-	-	.1	123	143	32	10	22
	-	-	1	103	162	23	14	20
	-	-	10	131	180	18	11	21
	+	-	.1	217	129	3	1	11
	+	-	1	215	174	2	3	8
	+	-	10	215	179	13	10	12

I. *Z. mays* plants were treated with Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate. of the compound.

BP10A20

TABLE 45

IN VITRO ASSAYS WITH *SALMONELLA TYPHIMURIUM*

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
				TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		165	92	28	7	7
	+	-		156	140	18	14	15
	-	+		110	61	12	4	4
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	-				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1		93			
	+	-	1		207			
	-	+	1		-			
Procyzazine, Technical	-	-	.1	170	75	17	1	8
	-	-	1	153	113	37	3	2
	-	-	10	174	156	22	12	8
	+	-	.1	106	141	32	16	5
	+	-	1	187	135	41	15	19
	+	-	10	117	123	49	15	26
	-	+	I ^a	200	197	40	5	8
	-	+	I ^b	208	208	46	3	4
	-	+	I ^c	252	212	61	8	10

I. *Z. mays* plants were treated with $4.79 \times 10^{-4}M$ (I^a), $9.58 \times 10^{-4}M$ (I^b), and $1.915 \times 10^{-3}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A18

TABLE 46

IN VITRO ASSAYS WITH *SALMONELLA TYPHIMURIUM*

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		162	70	18	5	7
	+	-		157	102	19	11	11
	-	+		103	59	12	3	3
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	-				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1		98			
	+	-	1		309			
	-	+	1		-			
Metolachlor, Commercial	-	-	.1	169	70	16	3	7
	-	-	1	152	111	10	8	4
	-	-	10	175	170	13	8	3
	+	-	.1	111	127	30	15	4
	+	-	1	192	135	21	9	11
	+	-	10	103	128	27	11	20
	-	+	I ^B	103	107	18	4	7
	-	+	I ^C	119	111	30	2	3
	-	+	I ^C	110	120	17	1	9

I. *Z. mays* plants were treated with $1.66 \times 10^{-5}M$ (I^a), $3.33 \times 10^{-5}M$ (I^b), and $3.33 \times 10^{-4}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A19

TABLE 47

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		139	130	15	9	4
	+	-		133	104	10	5	20
	-	+		153	151	3	7	6
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	518				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-			101			
	+	-	1		374			
	-	-	-		-			
Metolachlor, Technical	-	-	.1	241	174	8	9	9
	-	-	1	295	184	6	6	10
	-	-	10	260	160	13	11	11
	+	-	.1	219	228	11	2	11
	+	-	1	252	90	10	7	34
	+	-	10	322	141	10	3	40
	-	+	I ^a	139	174	4	7	7
	-	+	I ^b	128	147	3	8	8

I. Z. mays plants were treated with $1.66 \times 10^{-5}M$ (I^a) and $3.33 \times 10^{-5}M$ (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A17

TABLE 48

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	1S		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		139	113	15	9	4
	+	-		133	104	13	12	15
	-	+		143	109	10	11	19
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	698				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-	1		107			
	+	-	1		507			
	-	+	1		-			
Eradicane, Commercial	-	-	.1	108	148	24	10	7
	-	-	1	119	173	16	11	3
	-	-	10	144	140	19	11	8
	+	-	.1	96	93	11	4	23
	+	-	1	170	184	10	9	18
	+	-	10	157	119	13	9	22
-	-	+	I ^a	170	140	12	13	10
	-	+	I ^b	171	122	11	4	18

I. *Z. mays* plants were treated with $3.524 \times 10^{-6}M$ (I^a) and $3.524 \times 10^{-5}M$ (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated 1S was added/plate.

BP10A16

TABLE 49

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		72	74	7	3	8
	+	-		45	60	8	3	10
	-	+		75	84	7	5	7
Positive Control, NG ₁	-	-		>20,000				
	+	-		1047				
	-	+		>20,000				
Positive Control, AFB ₁	-	-	1		83			
	+	-	1		237			
	-	+	-		-			
Eradicane, Technical	-	-	.1	57	66	4	4	5
	-	-	1	45	59	7	5	6
	-	-	10	52	69	3	4	6
	+	-	.1	70	39	3	5	5
	+	-	1	47	41	9	3	11
	+	-	10	63	69	11	3	12
	-	+	I ^a	66	58	9	3	6
	-	+	I ^b	88	107	12	5	6
	-	+	I ^c	96	78	20	2	4
	-	+	I ^c					

I. Z. may plants were treated with $2.99 \times 10^{-5} M^a$, $2.99 \times 10^{-4} M^b$, and $2.99 \times 10^{-3} M^c$ of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A13

TABLE 50

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		121	84	7	6	3
	+	-		127	93	5	5	5
	-	+		140	103	7	6	2
Positive Control, NG	-	-		>20,000				
	+	-		-				
	-	+		>20,000				
Positive Control, AFB ₁	-	-			87			
	+	-			317			
	-	+						
Eradicane, Technical	-	-	.1	121	87	7	11	5
	-	-	.1	137	91	5	3	4
	-	-	10	142	69	9	4	2
	+	-	.1	150	90	5	9	1
	+	-	.1	121	87	4	8	9
	+	-	10	109	83	9	1	8
	-	+	1 ^a	152	111	6	11	1

I. Z. may's plants were treated with $2.99 \times 10^{-4} M$ (1^a) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated or untreated IS was added/plate.

BP10A93

TABLE 51

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE			
	S9	IS		TA100	TA98	TA1535	TA1537
Negative Control	-	-		119	143	16	12
	+	-		104	143	13	10
	-	+		98	125	8	7
Positive Control	-	-	30	>20,000			
	+	-	30				
	-	+	30	>20,000			
Positive Control	-	-	1		117		
	+	-	1		402		
	-	+	1				
Propachlor, Commercial	-	-	.1	138	156	27	12
	-	-	1	114	145	29	9
	-	-	10	139	155	31	11
	+	-	.1	104	155	23	19
	+	-	1	144	179	3	11
	+	-	10	120	156	12	17
	-	+	I ^a	84	131	9	3
	-	+	I ^b	88	124	10	6

I. *Z. mays* plants were treated with $1.306 \times 10^{-4}M$ (I^a) and $1.306 \times 10^{-3}M$ (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A4

TABLE 52

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	1S		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		80	90	11	5	15
	+	-		74	72	16	7	21
	-	+		125	133	7	8	14
Positive Control, NG ₁	-	-	30	>20,000				
	+	-	30	502				
	-	+	30	>20,000				
Positive Control, AFB ₁	-	-			98			
	+	-			271			
	-	+						
Propachlor, Technical	-	-	.1	64	88	13	6	29
	-	-	1	81	71	9	6	19
	-	-	10	63	72	8	8	8
	+	-	.1	75	91	17	9	12
	+	-	1	98	71	30	5	18
	+	-	10	78	84	18	10	20
	-	+	I ^a	222	162	2	6	20
	-	+	I ^b	115	160	2	4	17
	-	+	I ^c	138	192	3	5	21

I. Z. mays plants were treated with $6.53 \times 10^{-5}M$ (I^a), $1.306 \times 10^{-4}M$ (I^b), and $1.306 \times 10^{-3}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A3

TABLE 53
IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE			
				TA100	TA98	TA1535	TA1537 TA1538
Negative Control	-	-		64	41	8	4 7
	+	-		79	56	13	3 4
	-	+					
Positive Control, NG	-	-		>20,000			
	+	-		-			
	-	+		>20,000			
Positive Control, AFB ₁	-	-			48		
	+	-			371		
	-	+					
SD50093, Commercial	-	-	.1	78	47	9	3 13
	-	-	1	82	71	12	6 12
	-	-	10	69	60	11	7 11
	+	-	.1	77	57	13	3 7
	+	-	1	103	43	18	1 3
	+	-	10	87	81	12	2 9

BP10A96

TABLE 54

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-		87	43	6	4	3
	+	-		98	29	5	3	4
	-	+						
Positive Control, NG	-	-		>20,000				
	+	-		-				
	-	+		-				
Positive Control, AFB ₁	-	-			69			
	+	-			500			
	-	+						
SD50093, Technical 98	-	-	.1	96	70	7	3	2
	-	-	.1	84	51	3	4	1
	-	-	10	97	53	6	1	5
	+	-	.1	103	37	4	3	4
	+	-	.1	112	39	9	2	7
	+	-	10	93	40	2	3	5

BP10A97

TABLE 55

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	1S		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-						
	+	-						
	-	+						
Positive Control, NG ₁	-	-		188	182	4	11	26
	+	-	3	>20,000		64		
	-	-	3	471		-		
	-	+	3	>20,000		-		
Positive Control, AFB ₁	-	-	1		103			
	+	-	1		703			
	-	+	1					
Cyanazine (C)/ Alachlor (C)	-	+	1 ^a	202	216	20	16	9
	-	+	1 ^b	250	261	21	9	31
	-	+	1 ^c	361	147	37	21	35

I. Z. mays plants were treated with 3.15×10^{-4} M (B/A) I^a, 6.3×10^{-4} M (B/A) I^b, and 1.26×10^{-3} M (B/A) I^c of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated 1S was added/plate.

BP10A62

TABLE 56

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	1S		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-						
	+	-						
	-	+		95	74	16	5	8
Positive Control, NG ₁	-	-		>20,000				
	+	-		471				
	-	+		>20,000				
Positive Control, AFB ₁	-	-			103			
	+	-			703			
	-	+						
Alachlor (C)/ Dicamba (C)	-	+	I ^a	102	85	16	2	7
	-	+	I ^b	142	84	7	4	3
	-	+	I ^c	138	117	2	7	12

I. Z. mays plants were treated with $3.5 \times 10^{-6}M/1.07 \times 10^{-5}M$ (A/B) I^a, $7.0 \times 10^{-6}M/2.14 \times 10^{-5}M$ (A/B) I^b of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated 1S was added/plate.

BP10A64

TABLE 57
IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE			
	S-9	IS		TA100	TA98	TA1535	TA1537
Negative Control	-	-					TA1538
	+	-					
	-	+					
Positive Control, NG ₁	-	-		104	184	10	4
	+	-	>20,000				
	-	+	378				
Positive Control, AFB ₁	-	-	>20,000				
	+	-					
	-	+					
Procyclazine (C)/ Metolachlor (C)	-	-					
	+	-					
	-	+					
	-	+	I ^a				
	-	+	I ^b				
	-	+		152	227	9	2
				183	337	7	6
							1
							6

I. *Z. mays* plants were treated with 1.89 mg/pot/2.63 μ (C/D) I^a and 3.78 mg/pot/5.26 μ (C/D) I^b of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A61

TABLE 58

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE			
	S-9	1S		TA100	TA98	TA1535	TA1537
Negative Control	-	-					TA1538
	+	-					
	-	+					
Positive Control, NG ₁	-	-		168	119	7	9
	+	-		>20,000			11
	-	+		378			
	-	+		>20,000			
Positive Control, AFB ₁	-	-					
	+	-					
	-	+					
Metolachlor (T)/ Dicamba (T)	-	+	I ^a				
	-	+	I ^b				
				185	96	2	17
				95	74	2	15
							19
							8

I. Z. mays plants were treated with 0.473 mg/pot/0.095 mg/pot (D/B) I^a and 4.73 mg/pot/0.95 mg/pot (D/B) I^b, of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated 1S was added/plate.

BP10A59

TABLE 59

IN VITRO ASSAYS WITH *SALMONELLA TYPHIMURIUM*

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	IS		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-						
	+	-						
	-	+		129	155	10	8	11
Positive Control, NG ₁	-	-		>20,000				
	+	-		378				
	-	+		>20,000				
Positive Control, AFB ₁	-	-			100			
	+	-			651			
	-	+						
Alachlor (C)/ Bifenox (C)	-	+	I ^a	154	217	13	13	16
	-	+	I ^b	169	238	16	14	15
	-	+	I ^c	283	271	6	13	17

I. Z. mays plants were treated with 1.4×10^{-7} M/6.618 x 10^{-6} M (A/M) I^a, 1.4×10^{-6} M/6.618 x 10^{-5} M (A/M) I^b, and 1.4×10^{-5} M/6.618 x 10^{-4} M (A/M) I^c of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A63

TABLE 60

IN VITRO ASSAYS WITH SALMONELLA TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE			
				TA100	TA98	TA1535	TA1537 TA1538
Negative Control	-	-					
	+	-					
	-	+		137	119	13	18 11
Positive Control, NG ₁	-	-		>20,000			
	+	-		403			
	-	+		>20,000			
Positive Control, AFB ₁	-	-			193		
	+	-			398		
	-	+					
Propachlor (C)/ Cyanazine (C)	-	+	I ^a	187	288	2	31 108
	-	+	I ^b	100	379	1	20 152
	-	+	I ^c	60	843	2	23 369

I. *Z. mays* plants were treated with 2.90×10^{-4} M (P/B) I^a, 5.805×10^{-4} M (P/B) I^b, and 1.161×10^{-3} M (P/B) I^c of the compound. Homogenates were prepared according to the methods listed in this report, and 3 mg of treated IS was added/plate.

BP10A58

TABLE 61

IN VITRO ASSAYS WITH *SALMONELLA* TYPHIMURIUM

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND ADDED/PLATE	AVERAGE NUMBER OF HISTIDINE-POSITIVE REVERTANTS/PLATE				
	S-9	1S		TA100	TA98	TA1535	TA1537	TA1538
Negative Control	-	-						
	+	-						
	-	+		90	131	13	10	12
Positive Control, NG ₁	-	-	3	>20,000				
	+	-	3	403				
	-	+	3	>20,000				
Positive Control, AFB ₁	-	-			193			
	+	-			298			
	-	+						
Metolachlor (C)/ Atrazine (C)	-	-	^a	93	156	10	6	4
	-	-	^b	124	222	-	9	17
	-	-	^c	149	262	8	19	6

I. *Z. mays* plants were treated with

Homogenates were prepared according to the methods listed in this report, and 3 mg of treated 1S was added/plate.

BP10A60

TABLE 62

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
						ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	1.43	.66
	+	-			100	5.18	4.82
	-	+			100		
Positive Control, NG	-	-	30	-	10.1	45.7	31.2
	+	-	30	-	-		
	-	+	30	-	-		
Positive Control, AFB ₁	-	-	5	-	14.9	1.78	.72
	+	-	5	-	4.8	340	181
	-	+	5	-	-		
Curacron, Commercial	-	-	100	1:100	87	1.49	.13
	-	-		1:10	72.3	1.6	.2
	-	-		1:3	51	2.63	.61
	+	-	100	1:100		6.61	3.17
	+	-		1:10		5.	2.81
	+	-		1:3		3.77	5.16
	-	+	I ^a	-	75.1	2.74	2.01

Z. mays plants were treated with 3.75 mg/pot (I^a) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated 1S was added to each treatment tube.

BP10A53

TABLE 63

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION	S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
							ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-	-	-	-	100	1.17		0.91
	+	-	-	-	-	100	1.2		0.8
	-	+	+	-	-	100	1.03		0.14
Positive Control, NG	-	-	-	30	-	7.3	87.4		94.2
	+	-	-	30	-	14.8	1.2		0.67
	-	+	+	30	-	17.2	1.4		1.12
Positive Control, AFB ₁	-	-	-	5	-	15.1	1.3		0.97
	-	-	-	5	-	10.2	44.4		18.86
	-	+	+	5	-	8.9	1.21		0.79
Curacron, Technical	-	+	+	I ^a	-	87	1.9		1.3
	-	+	+	I ^b	-	73	1.2		.14
	-	+	+	I ^c	-	64	.38		.2

I. *Z. mays* plants were treated with 10 mg/pot (I^a), 20 mg/pot (I^b), and 40 mg/pot (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A52

TABLE 64

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
	S-9	IS				ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-			100	1.55		2.03
	+	-			100	8.1		2.65
	-	+			100	7.1		3.7
Positive Control, NG	-	-	30	-	18.2	27.6		15.7
	+	-	30	-	-			
	-	+	30	-	-			
Positive Control, AFB ₁	-	-	5	-	17.9	1.71		2.93
	+	-	5	-	8.7	24.71		51.46
	-	+	5	-	-			
Chlordane, Commercial	-	-	100	1:100	71	2.53		.66
	-	-	100	1:10	73	1.07		.82
	-	-		1:3	16	-		2.08
	+	-	100	1:100	72	8.4		2.61
	+	-		1:10	72	7.2		2.83
	+	-		1:3	.3	20		7.37
	-	+	I ^a	-	68	13.1		4.7
	-	+	I ^b	-	71	10.2		5.8
	-	+	I ^c	-	30	9.7		6.01

I. Z. mays plants were treated with $6.83 \times 10^{-5}M$ (I^a), $2.54 \times 10^{-4}M$ (I^b), and $5.34 \times 10^{-4}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A51

TABLE 65

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/10 ⁵ SURVIVORS		
	S-9	IS				ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-			100	2.68		.95
	+	-			100	6.72		2.28
	-	+			100	5.34		1.8
Positive Control, NG	-	-	30	-	18.2	27.6		15.7
	+	-	30	-	-			
	-	+	30	-	-			
Positive Control, AFB ₁	-	-	5	-	17.9	1.71		2.93
	+	-	5	-	8.7	24.71		51.46
	-	+	5	-	-			
Chlordane, Technical	-	-	100	1:100	73	3.84		.87
	-	-		1:10	58	-		.93
	-	-		1:3	21	2.98		1.04
	+	-	100	1:100	95	5.64		1.84
	+	-		1:10	82	7.31		5.32
	+	-		1:3	82	7.05		4.97
	-	+	I ^a	-	70	2.95		-
	-	+	I ^b	-	63	12.3		1.6
	-	+	I ^c	-	57	1.57		3.07

I. Z. mays plants were treated with $4.751 \times 10^{-6}M$ (I^a), $4.751 \times 10^{-5}M$ (I^b), and $4.751 \times 10^{-4}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A50

TABLE 66

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
						ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	2.57	2.23
	+	-			100	2.03	1.03
	-	+			100		
Positive Control, NG	-	-	30	-	3.7	703	357
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-	11.7	4.92	5.11
	+	-	5	-	5.1	149.21	111.27
	-	+	5	-			
Terbufos, Commercial	-	-	100	1:100	73	1.5	.88
	-	-		1:10	81	3.2	4.59
	-	-		1:3	60	6.65	.93
	+	-	100	1:100	26.3	2.72	.93
	+	-		1:10	24	1.98	-
	+	-		1:3	9.7	4.09	1.98

BP10A49

TABLE 67

IN VITRO ASSAYS WITH <u>SACCHAROMYCES CEREVISIAE</u> STRAIN D4								
<u>COMPOUND</u>	<u>METABOLIC ACTIVATION</u>		<u>ug COMPOUND TESTED</u>	<u>DILUTION</u>	<u>SURVIVAL: % OF CONTROL</u>	<u>MITOTIC GENE CONVERSION/10⁵ SURVIVORS</u>		
	<u>S-9</u>	<u>IS</u>				<u>ADE-2 LOCUS</u>	<u>TRP-5</u>	<u>LOCUS</u>
Negative Control	-	-			100	.89		.27
	+	-			100	1.3		.88
	-	+			100	.63		.3
Positive Control, NG	-	-	30	-	3.3	1300		170
	+	-	30	-				
	-	+	30	-				
Positive Control, AFB ₁	-	-	5	-	7.9	1.99		2.11
	+	-	5	-	2.7	148.11		214.76
	-	+	5	-				
Terbufos, Technical	-	-	100	1:100	39.4	4.51		.25
	-	-		1:10	25.1	5.56		.39
	-	-		1:3	7.9	7.29		-
	+	-	100	1:100	13.7	6.1		.91
	+	-		1:10	11.1	3.4		-
	+	-		1:3	20.3	6.9		1.51
	-	+	I ^a	-	71.3	.56		.11
	-	+	I ^b	-	50	.40		.2

Z. mays plants were treated with $7.55 \times 10^{-5}M$ (I^a) and $1.51 \times 10^{-4}M$ (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A48

TABLE 68

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	µg COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
						ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-						
	+	-			100	2.5	3	
	-	+			100	4	4.1	
Positive Control, NG	-	-			100	9.8	2.3	
	+	-	30	-	2.1	1576	408	
	-	+	30	-				
Positive Control, AFB ₁	-	-						
	+	-	5	-	.1	2.7	1.2	
	-	+	5	-	.1	8230	4300	
Fonofos, Commercial	-	-						
	-	-	100	1:100	44.1	2	8.6	
	-	-		1:10	41.7	2.1	10.1	
	+	-		1:3	2.6	2.8	6.9	
	-	-	100	1:100	39.2	8.5	3.1	
	+	-		1:10	35.6	8.1	1.2	
	-	-		1:3	24.8	-	4	
	-	+	I ^a					
	-	+	I ^b		35	8.8	2.1	
					25.3	4.7	.95	

Z. mays plants were treated with $1.54 \times 10^{-4}M$ (I^a) and $7.71 \times 10^{-4}M$ (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A42

TABLE 69

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
						ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	5.9	4.9
	+	-			100	1.2	2.3
	-	+			100	1	1.1
Positive Control, NG	-	-	30	-	2.1	1576	408
	+	-	30	-	-		
	-	+	30	-	-		
Positive Control, AFB ₁	-	-	5	-	.1	2.7	1.2
	+	-	5	-	.1	8230	4300
	-	+	5	-	-		
Fonofos, Technical	-	-	100	1:100	43	10.1	5
	-	-		1:10	45.9	16.1	4.8
	-	-		1:3	1.6	25.2	10.1
	+	-	100	1:100	42	2.1	2.2
	+	-		1:10	35.4	1.4	1.1
	+	-		1:3	16.1	3.1	1.8
	-	+	I ^a	-	21	.9	.7
	-	+	I ^b	-	18	1.1	1

Z. mays plants were treated with $1.54 \times 10^{-5}M$ (I^a) and $7.7 \times 10^{-5}M$ (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A43

TABLE 70

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4									
COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS			
	S-9	IS				ADE-2 LOCUS	TRP-5	LOCUS	
Negative Control	-	-			100	1.09	-	-	
	+	-			100	1.87	-	1.15	
	-	+			100		-	-	
Positive Control, NG ₁	-	-	30	-	6.7	3590	1891	-	
	+	-	30	-	68	503	-	-	
	-	+	30	-					
Positive Control, AFB ₁	-	-	5	-	.1	2.7	1.2	-	
	+	-	5	-	.1	8230	4300	-	
	-	+	5	-					
Carbofuran, Commercial	-	-	100	1:100	87	1.35	-	-	
	-	-		1:10	99	1.11	-	-	
	-	-		1:3	82	1.3	-	-	
	+	-	100	1:100	87	2.3	1.15	-	
	+	-		1:10	75	2.5	1.31	-	
	+	-		1:3	76	2.3	-	-	

TABLE 71

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/10 ⁵ SURVIVORS	
	S-9	1S				ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	1.67	1.88
	+	-			100	1.59	-
	-	+			100	1.42	3.33
Positive Control, NG ₁	-	-	30	-	6.7	3590	1891
	+	-	30	-	68	503	-
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-	14.1	1.47	2.79
	+	-	5	-	3.1	1511	2101
	-	+	5	-			
Carbofuran, Technical	-	-	100	1:100	61	3.11	1.98
	-	-		1:10	67	2.48	3.01
	-	-		1:3	98	1.71	2.41
	+	-	100	1:100	57	1.78	-
	+	-		1:10	68	2.81	-
	+	-		1:3	80	3.01	-
	-	+	I ^a	-	98	1.65	3.02
	-	+	I ^b	-	105	1.72	3.27
	-	+	I ^c	-	96	1.35	4.37

I. Z. mays plants were treated with $4.27 \times 10^{-4}M$ (I^a), $2.14 \times 10^{-3}M$ (I^b), and $4.27 \times 10^{-3}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated 1S was added to each treatment tube.

BP10A80

TABLE 72

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
	S-9	IS				ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-			100	2.7		1.3
	+	-			100	2.1		2.3
	-	+			100	1.6		1.3
Positive Control, NG ₁	-	-	30	-	.8	1736		2479
	+	-	30	-	-			
	-	+	30	-	-			
Positive Control, AFB ₁	-	-	5	-	8.2	2.9		1.5
	+	-	5	-	7.1	371.4		178.2
	-	+	5	-	-			
Heptachlor, Commercial	-	-	100	1:100	71	4.1		1.8
	-	-		1:10	43	-		1.3
	-	-		1:3	13	1.9		2.0
	+	-	100	1:100	47	2.3		2.7
	+	-		1:10	31	3.4		2.9
	+	-		1:3	20	3.8		3.8
	-	+	I ^a	-	-	1.3		1.5
	-	+	I ^b	-	-	-		1.1
	-	+	I ^c	-	-	1.5		1.5

I. *Z. mays* plants were treated with $8.85 \times 10^{-5}M$ (I^a), $4.85 \times 10^{-4}M$ (I^b), and $8.89 \times 10^{-4}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A79

TABLE 73

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
	S-9	IS				ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-			100	11.1		1.2
	+	-			100	7.8		2.3
	-	+			100	5.3		1.8
Positive Control, NG ₁	-	-	30	-	.8	1736		2479
	+	-	30	-				
	-	+	30	-				
Positive Control, AFB ₁	-	-	5	-	8.2	2.9		1.5
	+	-	5	-	7.1	371.4		178.2
	-	+	5	-				
Heptachlor, Technical	-	-	100	1:100	57	7.9		2.5
	-	-		1:10	40	9.6		2.2
	-	-		1:3	21	10.2		1.7
	+	-	100	1:100	42	9.3		3.7
	+	-		1:10	17	10.1		4.1
	+	-		1:3	12	13.2		2.8
	-	+	I ^a	-	38	2.4		1.9
	-	+	I ^b	-	27	6.6		-
	-	+	I ^c	-	21	4.8		2.3

I. *Z. mays* plants were treated with $8.89 \times 10^{-6}M$ (I^a), $8.89 \times 10^{-5}M$ (I^b), and $8.89 \times 10^{-4}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A78

TABLE 74

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
						ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-				1.16	1.48
	+	-			100	1.48	1.03
	-	+			100	1.17	1.21
Positive Control, NG ₁	-	-	30	-	.7	124.21	211.73
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-	8.9	1.17	1.72
	+	-	5	-	1.1	371.42	110.09
	-	+	5	-			
Chlorpyrifos, Commercial	-	-	100	1:100	48	1.62	1.57
	-	-		1:10	15	2.14	1.61
	-	-		1:3	11	2.01	1.59
	+	-	100	1:100	63	1.57	1.07
	+	-		1:10	61	1.63	2.01
	+	-		1:3	48	1.91	1.81
	-	+	I ^a		71	1.18	1.28
	-	+	I ^b		67	1.27	1.07
	-	+	I ^c		51	1.21	.99

I. *Z. mays* plants were treated with 5 mg/pot (I^a), 19 mg/pot (I^b), and 39 mg/pot (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A77

TABLE 75

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/10 ⁵ SURVIVORS	
	S-9	IS				ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	6.35	2.95
	+	-			100	5.71	5.31
	-	+			100	1	1.37
Positive Control, NG ₁	-	-	30	-	.7	124.21	211.73
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-	8.9	1.17	1.72
	+	-	5	-	1.1	371.42	110.09
	-	+	5	-			
Chlorpyrifos, Technical	-	-	100	1:100	57	2.6	2.17
	-	-		1:10	42	1.67	3.66
	-	-		1:3	17	6.45	4.32
	+	-	100	1:100	48	6.17	5.01
	+	-		1:10	19	6.01	4.72
	+	-		1:3	12	5.21	3.61
	-	+	I ^a		42	.93	1.31
	-	+	I ^b		37	.75	1.18
	-	+	I ^c		29	1.3	1.28

I. Z. mays plants were treated with 10 mg active/pot (I^a), 20 mg active/pot (I^b), and 40 mg active/pot (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A76

TABLE 76

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/10 ⁵ SURVIVORS	
	S-9	1S				ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	1.93	1.87
	+	-			100	2.13	1.72
	-	+			100	5.21	1.81
Positive Control, NG ₁	+	-	30	-	1.6	1057	-
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-	7.9	3.79	2.98
	+	-	5	-	8.6	479.92	682.11
	-	+	5	-			
Phorate, Commercial	-	-	100	1:100	38	1.82	1.97
	-	-		1:10	47	3.16	1.92
	-	-		1:3	21	2.71	2.51
	+	-	100	1:100	27	3.01	1.09
	+	-		1:10	26	1.76	2.13
	+	-		1:3	25	1.20	1.76
	-	+	I ^a	-	34	2.39	1.97
	-	+	I ^b	-	36	5.56	2.48
	-	+	I ^c	-	28	1.01	1.83

I. Z. mays plants were treated with $1.65 \times 10^{-4}M$ (I^a), $8.07 \times 10^{-4}M$ (I^b), and $1.65 \times 10^{-3}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated 1S was added to each treatment tube.

BP10A66

TABLE 77

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
	S-9	IS				ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	1.13	1.05
	+	-			100	1.14	1.27
	-	+			100	1.98	1.26
Positive Control, NG ₁	-	-	30	-	1.6	1057	
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-	7.9	3.79	2.98
	+	-	5	-	8.6	497.42	682.11
	-	+	5	-			
Phorate, Technical	-	-	100	1:100	21	1.68	1.15
	-	-		1:10	11	2.53	1.73
	-	-		1:3	18	.79	1.01
	+	-	100	1:100	25	.67	-
	+	-		1:10	17	.73	1.72
	+	-		1:3	13	.71	1.04
	-	+	I ^a	-	27	3.01	2.88
	-	+	I ^b	-	26	1.76	2.96
	-	+	I ^c	-	21	1.20	

I. *Z. mays* plants were treated with $3.95 \times 10^{-4}M$ (I^a), $1.97 \times 10^{-3}M$ (I^b), and $3.95 \times 10^{-4}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A65

TABLE 78

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION	S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
							ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-	-			100	1.2	1.6	
	+	-	-			100	4.3	2.4	
	-	+	+			100			
Positive Control, NG ₁	-	-	-	30	-	20	1050	-	
	+	-	-	30	-				
	-	+	+	30	-				
Positive Control, AFB ₁	-	-	-	5	-				
	+	-	-	5	-				
	-	+	+	5	-				
Metham, Commercial	-	-	-	100	1:100	141	.91	1.35	
	-	-	-		1:10	77	.74	1.69	
	-	-	-		1:3	101	.57	2.23	
	+	-	-	100	1:100	27	4.2	2.51	
	+	-	-		1:10	28	1.97	3.12	
	+	-	-		1:3	30	2.75	1.64	

BP10A68

TABLE 79

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

<u>COMPOUND</u>	<u>METABOLIC ACTIVATION</u>	<u>S-9</u>	<u>IS</u>	<u>ug COMPOUND TESTED</u>	<u>DILUTION</u>	<u>SURVIVAL: % OF CONTROL</u>	<u>MITOTIC GENE CONVERSION/ 10⁵ SURVIVORS</u>		
							<u>ADE-2 LOCUS</u>	<u>TRP-5</u>	<u>LOCUS</u>
Negative Control	-	-	-			100	1.13	1.27	
	+	-	-			100	1.54	4.63	
	-	+	+			100			
Positive Control, NG ₁	-	-	-	30	-	20	1050		
	+	-	-	30	-				
	-	+	+	30	-				
Positive Control, AFB ₁	-	-	-	5	-				
	+	-	-	5	-				
	-	+	+	5	-				
Metham, Technical	-	-	-	100	1:100	21	.7	1.36	
	-	-	-		1:10	11	2.03	2.01	
	-	-	-		1:3	18	1.7	1.03	
	+	-	-	100	1:100	113	1.82	3.15	
	+	-	-		1:10	80	1.32	3.85	
	+	-	-		1:3	92	1.54	5.04	

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BP10A67

TABLE 80

IN VITRO ASSAYS WITH SACHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	µg COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
						ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	1.24	.7
	+	-			100	5.37	1.86
	-	+			100	9.8	.68
Positive Control, NG	-	-	30	-	33.8	987	186
	+	-	30	-	-	-	-
	-	+	30	-	-	-	-
Positive Control, AFB ₁	-	-	5	-	4.9	3.72	4.26
	+	-	5	-	-	340	198
	-	+	5	-	-	-	-
Alachlor, Commercial	-	-	100	1:100	92	.67	.89
	-	-		1:10	74	1.04	1.11
	-	-		1:3	25	3.22	3.33
	+	-	100	1:100	59	1.35	2.01
	+	-		1:10	53	1.41	1.48
	+	-		1:3	20	8.63	-
	-	+	1 ^a	-	38	5.75	-
	-	+	1 ^b	-	22	4.21	.84
	-	+	1	-	-	-	-

Z. mays plants were treated with 7.0×10^{-4} M (1^a) and 1.4×10^{-3} M (1^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A57

TABLE 81

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
	S-9	IS				ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-			100	.33		.7
	+	-			100	4.82		1.28
	-	+			100	.63		.3
Positive Control, NG	-	-	30	-	33.8	987		186
	+	-			--	-		-
	-	+			-	-		-
Positive Control, AFB ₁	-	-	5	-	4.9	3.72		4.26
	+	-				340		198
	-	+				-		-
Alachlor, Commercial	-	-	100	1:100	63.1	.39		.6
	-	-		1:30	57.2	.5		.2
	-	-		1:10	41	.4		.2
	-	-		1:3	38.1	.53		.3
	+	-	100	1:100	59	1.11		1.18
I ^a I ^b I ^c I	+	-		1:10	27.9	3.58		1.04
	+	-		1:3	24.4	9.55		-
	-	+	I ^a	-	67	-		-
	-	+	I ^b	-	50.1	3.5		.2
	-	+	I ^c	-	43.2	1.7		.8

I. Z. mays plants were treated with $7.0 \times 10^{-5}M$ (I^a), $1.4 \times 10^{-4}M$ (I^b), and $1.4 \times 10^{-3}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A56

TABLE 82

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	µg COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
						ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	10.9	1.3
	+	-			100	.38	5.1
	-	+			100	11.5	7.9
Positive Control, NG	-	-	30	-	30	359	347
	+	-	30	-	-		
	-	+	30	-	-		
Positive Control AFB ₁	-	-	5	-	18.7	7.2	2.71
	+	-	5	-	48.1	399.62	487.11
	-	+	5	-	-		
Cyanazine, Commercial	-	-	100	1:100	118	4.8	1.3
	-	-		1:10	121	10.1	1.4
	-	-		1:3	103	2.5	.97
	+	-	100	1:100	90	.57	4.24
	+	-		1:10	115	.33	2.22
	+	-		1:3	104	.37	4.91
	-	+	I ^a	-	98	-	6.13
	-	+	I ^b	-	105	9.54	7.4
	-	+	I ^c	-	122	18.13	8.9

I. Z. mays plants were treated with $5.17 \times 10^{-4}M$ (I^a), $5.17 \times 10^{-3}M$ (I^b), and $2.57 \times 10^{-2}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A39

TABLE 83

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
						ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	.89	.26
	+	-			100	1.67	.89
	-	+			100		
Positive Control, NG	-	-	30	-	3.3	1300	17
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-	7.1	.99	.34
	+	-	5	-	2.1	127.12	261.11
	-	+	5	-			
Cyanazine, Technical	-	-	100	1:100	24	.64	-
	-	-		1:10	46.7	.32	.4
	-	-		1:3	23.4	.69	.36
	+	-	100	1:100	62.3	.9	.88
	+	-		1:10	70.	1.43	.8
	+	-		1:3	30.3	2	.71

BP10A38

TABLE 84

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
						ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	2.25	2.04
	+	-			100	2.54	1.42
	-	+			100		
Positive Control, NG	-	-	30	-	12	501	150
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-	2.7	2.49	2.57
	+	-	5	-	4.8	177.92	210.93
	-	+	5	-	-		
Dicamba, Commercial	-	-	100	1:100	32.2	.41	.31
	-	-		1:10	28.2	.37	-
	-	-		1:3	3.1	1.01	.7
	+	-	100	1:100	89.4	3.51	1.99
	+	-		1:10	52.1	5.13	2.68
	+	-		1:3	47	2.17	1.57

BP10A55

TABLE 85

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION	S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
							ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-	-	-	-	100	6.43	1.75	
	+	-	-	-	-	100	8.07	.56	
	-	+	+	-	-	100	11.59	4.76	
Positive Control, NG	-	-	-	30	-	12	501	150	
	+	-	-	30	-				
	-	+	+	30	-				
Positive Control, AFB ₁	-	-	-	5	-	2.7	2.49	2.57	
	+	-	-	5	-	4.8	177.92	210.93	
	-	+	+	5	-				
Dicamba, Technical	-	-	-	100	1:100	68.3	5.66	1.83	
	-	-	-	-	1:10	64.7	5.05	2.41	
	-	-	-	-	1:3	79.1	2.73	1.97	
	+	-	-	100	1:100	76.1	7.8	.74	
	+	-	-	-	1:10	82.3	14.4	.69	
	-	-	-	-	1:3	79	3.19	1.58	
	-	+	+	I ^a	-	10.5	7.12	1.27	
	-	+	+	I ^b	-	12.1	4.78	1.81	
	-	-	-	I	-				

Z. mays plants were treated with 2.675 x 10⁻⁵M (I^a) and 5.35 x 10⁻⁵M (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A54

TABLE 86

IN VITRO ASSAYS WITH *SACCHAROMYCES CEREVISIAE* STRAIN D4

COMPOUND	METABOLIC ACTIVATION		µg COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
	S-9	IS				ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	8.6	2.7
	+	-			100	6.4	.59
	-	+			100		
Positive Control, NG	-	-	30	-	7.1	1723	1201
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-	17.9	8.11	3.72
	+	-	5	-	7.6	511.62	718.1
	-	+	5	-			
Procyzazine, Commercial	-	-	100	1:100	78	8.3	2.6
	-	-		1:10	51	6.6	-
	-	-		1:3	40	4.4	3.9
	+	-	100	1:100	41.9	10.6	.61
	+	-		1:10	18.6	3.9	.53
	+	-		1:3	34.3	7.7	.58

TABLE 87

IN VITRO ASSAYS WITH *SACCHAROMYCES CEREVISIAE* STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
	S-9	1S				ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-			100	4.6	1.7	
	+	-			100	5.0	1.9	
	-	+			100	2.9	3.2	
Positive Control, NG	-	-	30	-	10	1572		639
	+	-	30	-				
	-	+	30	-				
Positive Control, AFB ₁	-	-	5	-	17	3.93	.78	
	+	-	5	-	8	201	87	
	-	+	5	-	-	-	-	
Procayazine, Technical	-	-	100	1:100	39	6.2	1.3	
	-	-		1:10	27	1.1	1.8	
	-	-		1:3	10	2.4	6.6	
	+	-	100	1:100	42	4.3	-	
	+	-		1:10	17	4.0	4.5	
	+	-		1:3	18	6.2	1.0	
	-	+	I ^a	-	42	5.6	4.2	
	-	+	I ^b	-	18	2.8	2.4	
	-	+	I ^c	-	16	5.3	3.6	

I. *Z. mays* plants were treated with $4.79 \times 10^{-4}M$ (I^a), $9.58 \times 10^{-4}M$ (I^b), and $1.915 \times 10^{-3}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated 1S was added to each treatment tube.

TABLE 88

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
						ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-			100	3.1	1.4	
	+	-			100	8.63	3.12	
	-	+			100	.63	.3	
Positive Control, NG	-	-	30	-	3.3	1300	708	
	+	-	30	-	-			
	-	+	30	-	-			
Positive Control AFB ₁	+	-	5	-	4.8	2.98	1.76	
	+	-	5	-	7.1	109.07	98.3	
	-	+	5	-	-			
Metolachlor, Technical	-	-	100	1:100	17	3.1	-	
	-	-		1:10	14.2	1.4	1.4	
	-	-		1:3	10	2.9	2.01	
	+	-	100	1:100	65.7	5.08	3.97	
	+	-		1:10	41.4	19.4	5.12	
	+	-		1:3	9.3	39.6	6.20	
	-	+	I ^a	-	18	.88	.15	
	-	+	I ^b	-	7.3	.34	.8	

Z. mays plants were treated with $1.66 \times 10^{-5}M$ (I^a) and $3.33 \times 10^{-5}M$ (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A45

TABLE 89

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4						
COMPOUND	S-9	METABOLIC ACTIVATION	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL
Negative Control	-	-	-			8.7
	+	-	-			100
	-	+	+			100
Positive Control, NG	-	-	-	30	-	100
	+	-	-	30	-	100
	-	+	+	30	-	100
Positive Control, AFB ₁	-	-	-	5	-	3.3
	+	-	-	5	-	1300
	-	+	+	5	-	708
Metolachlor, Commercial	-	-	-	100	1:100	2.48
	-	-	-		1:10	98.3
	-	-	-		1:3	1.7
	+	-	-	100	1:100	1.4
	+	-	-		1:10	1.2
	+	-	-		1:3	2.4
	-	+	+	I ^a	-	3.7
	-	+	+			3.1
	-	-	-			.28
					40.1	.27

Z. mays plants were treated with $3.524 \times 10^{-6} \text{M}$ (I^a) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A44

TABLE 90

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
	S-9	IS				ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	.18	.3
	+	-			100	.8	.3
	-	+			100	.63	.32
Positive Control, NG	-	-	30	-	3	43.50	175
	+	-	30	-	37	380	18
	-	+	30	-	-	-	-
Positive Control, AFB ₁	-	-	5	-	7	.27	.59
	+	-	5	-	5.9	121.7	139.82
	-	+	5	-	-	-	-
Eradicane, Commercial	-	-	100	1:100	81.1	.17	.23
	-	-		1:10	42.7	.16	.24
	-	-		1:3	-	-	-
	+	-	100	1:100	87	.7	.24
	+	-		1:10	83	1.2	.3
	+	-		1:3	82	-	.41
	-	+	I ^a	-	73	.67	1.1
	-	+	I ^b	-	69	.38	.47

I. Z. mays plants were treated with 3.524 x 10⁻⁶M (I^a) and 3.524 x 10⁻⁵M (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A41

TABLE 91

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
						ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-				1.13	1.38
	+	-			100	1.47	.98
	-	+			100	1.98	2.5
Positive Control, NG ₁	-	-	30	-	26.7	1050	-
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-	5.8	1.27	1.47
	+	-	5	-	9.4	211.72	298.39
	-	+	5	-			
Eradicane, Technical	-	-	100	1:100	38.1	1.21	1.27
	+	-		1:10	27.2	1.42	1.41
	-	-		1:3	11.1	1.51	1.31
	+	-	100	1:100	27.8	.78	.89
	+	-		1:10	22.7	1.07	.99
	+	-		1:3	7.7	2.76	1.43
	-	+	I ^a	-	119	1.71	.6
	-	+	I ^b	-	143	1.69	3.1
	-	+	I ^c	-	97.3	3.61	2.1

I. *Z. mays* plants were treated with $2.995 \times 10^{-4} M$ (I^a), $1.498 \times 10^{-3} M$ (I^b), and $2.995 \times 10^{-3} M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

TABLE 92

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
						ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-						
	+	-			100	4.7		1.3
	-	+			100	4.8		2.1
Positive Control, NG ₁	-	-	30	-	100	5		1.3
	+	-	30	-	2.3	8631		1401
	-	+	30	-				
Positive Control, AFB ₁	-	-	5	-	17.2	5.91		2.1
	+	-	5	-	9.7	333.61		402.72
	-	+	5	-				
Propachlor, Commercial	-	-	100	1:100	37	4.6		2.0
	-	-		1:10	48	1.1		1.7
	-	-		1:3	29	.8		.6
	+	-	100	1:100	38	16		1.0
	+	-		1:10	38	8		3.0
	+	-		1:3	41	17		2.7
	-	+	I ^a					
	-	+	I ^b	-	49	18		2.6
	-	+		-	37	31		4.2

I. Z. mays plants were treated with $1.306 \times 10^{-4}M$ (I^a) and $1.306 \times 10^{-3}M$ (I^b) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A72

TABLE 93

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
						ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100	1.5	1.7
	+	-			100	4.8	1.1
	-	+			100	5.3	1.2
Positive Control, NG ₁	-	-	30	-	2.3	8631	1401
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-	17.2	5.91	2.1
	+	-	5	-	9.7	333.61	402.72
	-	+	5	-			
Propachlor, Technical	-	-	100	1:100	48	1.1	1.9
	-	-		1:10	20	1	2.5
	-	-		1:3	13	3.5	1.8
	+	-	100	1:100	24	2.2	3
	+	-		1:10	30	2.7	3.7
	+	-		1:3	18	1.9	1.2
	-	+	I ^a	-	47	17	3.5
	-	+	I ^b	-	25	42	4.7
	-	+	I ^c	-	28	38	2.9

I. Z. mays plants were treated with $6.53 \times 10^{-5}M$ (I^a), $1.306 \times 10^{-4}M$ (I^b), and $1.306 \times 10^{-3}M$ (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated 1S was added to each treatment tube.

BP10A73

TABLE 94

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION	S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
							ADÉ-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-	-	-	-	100	2.48	3.01	
	+	-	-	-	-	100	2.17	3.12	
	-	+	+	-	-	100	1.97	4.22	
Positive Control, NG ₁	-	-	-	30	-	7	1050		
	+	-	-	30	-				
	-	+	+	30	-				
Positive Control, AFB ₁	-	-	-	5	-	4.7	1.57		
	+	-	-	5	-	1.7	211.46		
	-	+	+	5	-				
Bifenox, Commercial	-	-	-	100	1:100	24	2.48	2.71	
	-	-	-	-	1:10	33	2.03	2.91	
	-	-	-	-	1:3	28	2.53	3.48	
	+	-	-	100	1:100	27	2.51	3.12	
	+	-	-	-	1:10	19	2.70	3.14	
	+	-	-	-	1:3	26	2.63	2.16	
	-	+	+	1 ^a	-	40	1.82	2.48	
	-	+	+	1 ^b	-	25	2.83	8.10	
	-	+	+	1 ^c	-	35	1.49	7.47	

1. Z. mays plants were treated with $8.84 \times 10^{-4}M$ (1^a), $8.84 \times 10^{-3}M$ (1^b), and $1.77 \times 10^{-2}M$ (1^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

TABLE 95

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	METABOLIC ACTIVATION IS	µg COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
							ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-	-			100	1.13	-	-
	+	-	-			100	1.37	1.51	-
	-	+	+			100	2.56	7.1	-
Positive Control, NG ₁	-	-	-	30	-	7	1050	-	-
	+	-	-	30	-	-	-	-	-
	-	+	+	30	-	-	-	-	-
Bifenox, Technical	-	-	-	100	1:100	47	1.27	-	-
	-	-	-		1:10	17	1.46	-	-
	-	-	-		1:3	13	1.09	-	-
	+	-	-	100	1:100	14	1.13	1.5	-
	+	-	-		1:10	24	1.56	1.47	-
	+	-	-		1:3	12	2.08	1.79	-
	-	+	+	I ^a	-	166	3.07	8.4	-
	-	+	+	I ^b	-	89	-	8.1	-
	-	+	+	I ^c	-	104	1.42	6.9	-

I. Z. mays plants were treated with 4.5×10^{-4} M (I^a), 9.0×10^{-4} M (I^b), and 9.0×10^{-3} M (I^c) of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A74

TABLE 96

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION S-9	IS	µg COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
						ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-						
	+	-			100	6.43	1.37	
	-	+			100	4.05	2.25	
Positive Control, NG ₁	-	-	30	-				
	+	-	30	-	1.7	1112		
	-	+	30	-				
Positive Control, AFB ₁	-	-	5	-				
	+	-	5	-	21.7	7.37	1.99	
	-	+	5	-	12.2	507.7	411	
SD50093, Commercial	-	-	100	1:100				
	-	-		1:10	98	3.67	1.36	
	-	-		1:3	89	3.12	1.47	
	+	-	100	1:100	51	2.35	1.80	
	+	-		1:10	20	4.57	2.28	
	+	-		1:3	4	3.16	1.45	
					2	1.23	1.09	

TABLE 97

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION	S-9	1S	µg COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
							ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-	-	-	-	100	1.79	2.96	
	+	-	-	-	-	100	4.57	2.25	
	-	+	+	-	-	100			
Positive Control, NG ₁	-	-	-	30	-	1.7	1112		
	+	-	-	30	-				
	-	+	+	30	-				
Positive Control, AFB ₁	-	-	-	5	-	21.7	7.3	1.99	
	+	-	-	5	-	12.2	507.7	411	
	-	+	+	5	-				
SD50093, Technical	-	-	-	100	1:100	30	2.21	1.77	
	-	-	-		1:10	48	4.14	4.14	
	-	-	-		1:3	21	3.27	3.28	
	+	-	-	100	1:100	27	3.32	3.69	
	+	-	-		1:10	28	4.31	1.51	
	+	-	-		1:3	27	3.61	3.97	

TABLE 98

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
	S-9	IS				ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100		
	+	-			100		
	-	+			100	1.97	4.22
Positive Control, NG ₁	-	-	30	-	12	1872	498
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-			
	+	-	5	-			
	-	+	5	-			
Cyanazine (C)/ Alachlor (C)	-	+	I ^a	-	36	1.94	4.63
	-	+	I ^b	-	31	1.42	1.09
	-	+	I ^c	-	24	1.17	1.37

142

I. Z. mays plants were treated with 3.15×10^{-4} M/ 3.5×10^{-5} (B/A) I^a, 6.30×10^{-4} M/ 7.00×10^{-5} M (B/A) I^b, and 1.26×10^{-3} M/ 1.40×10^{-4} M (B/A) I^c of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A83

TABLE 99

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
	S-9	IS				ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100		
	+	-			100		
	-	+			100		
Positive Control, NG ₁	-	-	30	-	12	5.21	1.81
	+	-	30	-			
	-	+	30	-		1872	498
Positive Control, AFB ₁	-	-	5	-			
	+	-	5	-			
	-	+	5	-			
Alachlor (C)/ Dicamba (C)	-	+	I ^a	-	18.3	1.96	2.56
	-	+	I ^b	-	3.9	5.47	1.98
	-	+		-			

143

I. Z. mays plants were treated with 3.5×10^{-6} M/1.07 $\times 10^{-5}$ M (A/B) I^a and 7.0×10^{-6} M/2.14 $\times 10^{-5}$ M (A/B) I^b of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A84

TABLE 100

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
	S-9	IS				ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100		
	+	-			100		
	-	+			100		
Positive Control, NG ₁	-	-	30	-	7.1	2.9	3.2
	+	-	30	-			
	-	+	30	-		639	407
Positive Control, AFB ₁	-	-	5	-			
	+	-	5	-			
	-	+	5	-			
Procymazine (C)/Metolachlor (C)	-	+	I ^a	-	48	3.6	2.3
	-	+	I ^b	-	32	6.2	4.3
	-	+	I	-			

144

I. Z. mays plants were treated with 1.89 mg/pot/2.63% (C/D) I^a and 3.78 mg/pot/5.26% (C/D) I^b of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A85

TABLE 101

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS		
	S-9	IS				ADE-2 LOCUS	TRP-5	LOCUS
Negative Control	-	-			100			
	+	-			100			
	-	+			100	1.1		.1
Positive Control, NG ₁	-	-	30	-				
	+	-	30	-	3.7	501		492
	-	+	30	-				
Positive Control, AFB ₁	-	-	5	-				
	+	-	5	-				
	-	+	5	-				
Metolachlor (C)/ Dicamba (C)	-	+	I ^a	-	43	1.9		.35
	-	+	I ^b	-	37	2.3		.7
	-	+	I ^c	-	29	2.1		.8

I. Z. mays plants were treated with 0.473 mg/pot/0.095 mg/pot (D/B) I^a, 4.73 mg/pot/0.95 mg/pot (D/B) I^b, and 47.3 mg/pot/9.5 mg/pot (D/B) I^c of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A86

TABLE 102

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION		ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
	S-9	1S				ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-			100		
	+	-			100		
	-	+			100	1.12	.3
Positive Control, NG ₁	-	-	30	-	2.8	1112	371
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-			
	+	-	5	-			
	-	+	5	-			
Alachlor (C)/ Bifenox (C)	-	+	I ^a		47	1.3	.35
	-	+	I ^b		23	1.6	.42
	-	+	I ^c		17	1.8	.46

I. Z. mays plants were treated with 1.4×10^{-7} M/6.618 x 10^{-6} M (A/M), 1.4×10^{-6} M/6.618 x 10^{-5} M (A/M) I^b, and 1.4×10^{-5} M/6.618 x 10^{-4} M (A/M) I^c of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated 1S was added to each treatment tube.

BP10A88

TABLE 103

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

<u>COMPOUND</u>	<u>METABOLIC ACTIVATION</u>		<u>ug COMPOUND TESTED</u>	<u>DILUTION</u>	<u>SURVIVAL: % OF CONTROL</u>	<u>MITOTIC GENE CONVERSION/10⁵ SURVIVORS</u>	
	<u>S-9</u>	<u>IS</u>				<u>ADE-2 LOCUS</u>	<u>TRP-5 LOCUS</u>
Negative Control	-	-			100		
	+	-			100		
	-	+			100	.45	.1
Positive Control, NG ₁	-	-	30	-	.8	937	104
	+	-	30	-			
	-	+	30	-			
Positive Control, AFB ₁	-	-	5	-			
	+	-	5	-			
	-	+	5	-			
Cyanazine (C)/Propachlor (C)	-	+	I ^a	-	47	1.12	.69

147

I. *Z. mays* plants were treated with $3.14 \times 10^{-4} \text{M}$ /2.903 $\times 10^{-4} \text{M}$ (B/P) I^a of the compound. Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated IS was added to each treatment tube.

BP10A89

TABLE 104

IN VITRO ASSAYS WITH SACCHAROMYCES CEREVISIAE STRAIN D4

COMPOUND	METABOLIC ACTIVATION	S-9	IS	ug COMPOUND TESTED	DILUTION	SURVIVAL: % OF CONTROL	MITOTIC GENE CONVERSION/ 10 ⁵ SURVIVORS	
							ADE-2 LOCUS	TRP-5 LOCUS
Negative Control	-	-	-			100		
	+	-	-			100		
	-	+	+			100	1.23	.98
Positive Control, NG	-	-	-	30	-	12	1379.6	412.78
	+	-	-	30	-			
	-	+	+	30	-			
Positive Control, NG ₁	-	-	-	5	-			
	+	-	-	5	-			
	-	+	+	5	-			
Metolachlor(T)/ Atrazine (A)	-	-	+	1 ^a	37	1.75	1.01	

Z. mays plants were treated with Homogenates were prepared according to the methods listed in this report, and 15 mg of treated or untreated 1S was added to each treatment tube.

BP10A98

TABLE 105
SUMMARY OF IN SITU ASSAYS

Pesticide	Classification	Year	Data Table
Insecticide Control	NA	1976	106
Curacron	Insecticide	1976	107
Chlordane	Insecticide	1976	108
Terbufos	Insecticide	1976	109
Fonofos	Insecticide	1976	110
Carbofuran	Insecticide	1976	111
Heptachlor	Insecticide	1976	112
Chlorpyrifos	Insecticide	1976	113
Ethoprop	Insecticide	1976	114
Metham	Insecticide	1976	115
Phorate	Insecticide	1976	116
Herbicide Control	NA	1976	117
Cyanazine	Herbicide	1976	118
Procyazine	Herbicide	1976	119
Bifenox	Herbicide	1976	120
SD50093	Herbicide	1976	121
Metolachlor + Dicamba	Herbicide	1976	122
Metolachlor + Procyazine	Herbicide	1976	123
Alachlor + Dicamba	Herbicide	1976	124
Bifenox + Alachlor	Herbicide	1976	125
Bifenox + Alachlor	Herbicide	1976	126
Herbicide Controls	NA	1977	127
Atrazine	Herbicide	1977	128
Cyanazine	Herbicide	1977	129
Metolachlor	Herbicide	1977	130
Metolachlor	Herbicide	1977	131
Eradicane (EPTC)	Herbicide	1977	132
Alachlor	Herbicide	1977	133
SD50093	Herbicide	1977	134
Simazine	Herbicide	1977	135
Butylate	Herbicide	1977	136
Metolachlor + Atrazine	Herbicide	1977	137
Metolachlor + Dicamba	Herbicide	1977	138
Metolachlor + Cyanazine	Herbicide	1977	139
Eradicane + Atrazine	Herbicide	1977	140
Eradicane + Cyanazine	Herbicide	1977	141
Propachlor + Cyanazine	Herbicide	1977	142
Butylate + Atrazine	Herbicide	1977	143
Butylate + Cyanazine	Herbicide	1977	144
Herbicide Controls	NA	1978	145
Dicamba	Herbicide	1978	146
Propachlor	Herbicide	1978	147

TABLE 106
Maize waxy Locus Assay

Pesticide Name Insecticide Control

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1056-1	10	375,282	2.66
1056-2	22	230,372	9.55
1056-3	5	241,982	2.07
1069-1	19	229,405	8.28
1069-2	4	293,690	1.36
1069-3	6	212,635	2.82
1070-1	4	214,032	1.87
1070-2	9	194,037	4.64
Totals	79	1,991,435	

$$p_w = 3.97 \times 10^{-5}$$

$$V_w = 8.689 \times 10^{-11}$$

$$p_u = 4.156 \times 10^{-5}$$

$$V_u = 1.254 \times 10^{-10}$$

$$\text{Control } x2 = 7.94 \times 10^{-5}$$

$$t = \text{NA}$$

$$\phi = \text{NA}$$

$$u = 3.970 \times 10^{-5} \text{ to } 4.156 \times 10^{-5}$$

TABLE 107
Maize waxy Locus Assay

Pesticide Name CGA-20G

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1059-1	30	440,750	6.807
1059-2	26	416,347	6.245
1059-3	28	391,085	7.160
Totals	84	1,248,182	

$$p_w = 6.730 \times 10^{-5}$$

$$V_w = 2.327 \times 10^{-12}$$

$$p_u = 6.737 \times 10^{-5}$$

$$V_u = 7.098 \times 10^{-12}$$

$$\text{Control } x_2 = - (6.730 < 7.940)$$

$$t = - (1.39)$$

$$\phi = - (3.33)$$

$$u = 6.730 \times 10^{-5} \text{ to } 6.737 \times 10^{-5}$$

TABLE 108
Maize waxy Locus Assay

Pesticide Name Chlordane
Octachloro-4, 7-methanotetrahydroindane

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1066-1	16	98,685	16.21
1066-2	24	235,855	10.18
1066-3	15	202,852	7.39
1066-4	8	156,735	5.10
Totals	63	856,452	

$$p_w = 7.356 \times 10^{-5}$$

$$V_w = 6.835 \times 10^{-10}$$

$$p_u = 9.720 \times 10^{-5}$$

$$V_u = 5.756 \times 10^{-10}$$

$$\text{Control } x^2 = + (9.72 > 7.94)$$

$$t = + (2.46) \quad P < 0.025$$

$$\phi = - (3.62)$$

$$u = 7.356 \times 10^{-5} \text{ to } 9.720 \times 10^{-5}$$

TABLE 109
Maize waxy Locus Assay

Pesticide Name Counter (Terbufos)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1049-1	20	218,225	9.16
1049-2	27	179,417	15.05
1049-3	3	198,875	1.51
1049-4	7	195,542	3.58
1049-5	16	207,797	7.70
Totals	73	999,857	

$$p_w = 7.301 \times 10^{-5}$$

$$v_w = 4.656 \times 10^{-10}$$

$$p_u = 7.400 \times 10^{-5}$$

$$v_u = 5.550 \times 10^{-10}$$

$$\text{Control } x_2 = -(7.301 < 7.940)$$

$$t = - (1.41)$$

$$\phi = - (3.73)$$

$$u = 7.301 \times 10^{-5} \text{ to } 7.400 \times 10^{-5}$$

TABLE 110
Maize waxy Locus Assay

Pesticide Name Dyfonate (Fonofos)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1041-1	3	167,592	1.79
1041-2	27	183,502	14.71
1041-3	21	265,310	7.92
1041-4	5	278,102	1.80
1041-5	13	229,190	5.67
Totals	69	1,123,697	

$$p_w = 6.140 \times 10^{-5}$$

$$v_w = 3.848 \times 10^{-10}$$

$$p_u = 6.378 \times 10^{-5}$$

$$v_u = 5.715 \times 10^{-10}$$

$$\text{Control } x^2 = - (6.140 < 7.940)$$

$$t = - (0.96)$$

$$\phi = - (2.59)$$

$$u = 6.140 \text{ to } 6.378 \times 10^{-5}$$

TABLE 111
Maize waxy Locus Assay

Pesticide Name Furadan (Carbofuran)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1046-1	41	507,292	8.08
1046-2	28	469,667	5.96
1046-3	22	500,413	4.40
Totals	91	1,477,372	

$$p_w = 6.160 \times 10^{-5}$$

$$V_w = 1.276 \times 10^{-10}$$

$$p_u = 6.147 \times 10^{-5}$$

$$V_u = 1.140 \times 10^{-10}$$

$$\text{Control } x^2 = - (6.147 < 7.94)$$

$$t = - (1.02)$$

$$\phi = - (2.81)$$

$$u = 6.147 \text{ to } 6.160 \times 10^{-5}$$

TABLE 112
Maize waxy Locus Assay

Pesticide Name Heptachlor

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1064-1	32	189,307	16.904
1064-2	14	218,762	6.400
1064-3	9	185,115	4.862
1064-4	21	137,277	15.298
Totals	76	730,461	

$$p_w = 10.404 \times 10^{-5}$$

$$V_w = 6.579 \times 10^{-10}$$

$$p_u = 10.87 \times 10^{-5}$$

$$V_u = 9.385 \times 10^{-10}$$

$$\text{Control } x^2 = + (10.40 > 7.94)$$

$$t = + (2.58 \text{ } P < 0.025)$$

$$\phi = + (6.15)$$

$$u = 10.40 \text{ to } 10.87 \times 10^{-5}$$

TABLE 113
Maize waxy Locus Assay

Pesticide Name Lorsban (Chlorpyrifos)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1040-1	8	539,757	1.48
1040-2	18	392,160	4.59
1040-3	18	674,240	2.67
Totals	44	1,606,157	

$$p_w = 2.739 \times 10^{-5}$$

$$V_w = 2.190 \times 10^{-11}$$

$$p_u = 2.914 \times 10^{-5}$$

$$V_u = 8.199 \times 10^{-11}$$

$$\text{Control } x^2 = - (2.739 < 7.94)$$

$$t = - (0.65)$$

$$\phi = - (2.07)$$

$$u = 2.739 \text{ to } 2.914 \times 10^{-5}$$

TABLE 114
Maize waxy Locus Assay

Pesticide Name Mocap (Ethoprop)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1055-1	52	347,225	14.98
1055-2	33	380,120	8.681
1055-3	18	456,767	3.941
1055-4	21	381,947	5.498
Totals	124	1,566,059	

$$p_w = 7.918 \times 10^{-5}$$

$$v_w = 3.675 \times 10^{-10}$$

$$p_u = 8.275 \times 10^{-5}$$

$$v_u = 5.968 \times 10^{-10}$$

$$\text{Control } x^2 = - (7.918 < 7.94)$$

$$t = + (1.80) P < 0.05$$

$$\phi = + (4.83)$$

$$u = 7.918 \text{ to } 8.275 \times 10^{-5}$$

TABLE 115
Maize waxy Locus Assay

Pesticide Name SRA-15

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1062-1	52	527,610	9.856
1062-2	25	509,872	4.903
1062-3	33	567,385	5.816
Totals	110	1,604,867	

$$p_w = 6.854 \times 10^{-5}$$

$$v_w = 2.195 \times 10^{-10}$$

$$p_u = 6.858 \times 10^{-5}$$

$$v_u = 2.316 \times 10^{-10}$$

$$\text{Control } x_2 = - (6.85 < 7.94)$$

$$t = - (1.33)$$

$$\phi = - (3.68)$$

$$u = 6.854 \text{ to } 6.858 \times 10^{-5}$$

TABLE 116
Maize waxy Locus Assay

Pesticide Name Thimet (Phorate)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1051-1	37	629,197	5.881
1051-2	12	426,022	2.817
1052-1	26	835,490	3.112
1052-2	29	660,372	4.391
Totals	104	2,551,081	

$$p_w = 4.077 \times 10^{-5}$$

$$V_w = 3.868 \times 10^{-11}$$

$$p_u = 4.050 \times 10^{-5}$$

$$V_u = 4.954 \times 10^{-11}$$

$$\text{Control } x^2 = - (4.077 < 7.940)$$

$$t = - (0.06)$$

$$\phi = - (0.11)$$

$$u = 4.050 \times 10^{-5} \text{ to } 4.077 \times 10^{-5}$$

TABLE 117
Maize waxy Locus Assay

Pesticide Name Herbicide Controls (1976)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
922	8	222,202	3.600
945-1	6	200,165	2.998
945-2	19	421,937	4.503
958-1	54	649,515	8.314
958-2	9	336,152	2.677
1026	20	205,540	9.730
1070-1	9	166,195	5.415
1070-3	11	204,680	5.374
1070-4	9	182,212	4.939
Totals	145	2,588,598	

$$p_w = 5.601 \times 10^{-5}$$

$$V_w = 2.031 \times 10^{-10}$$

$$p_u = 5.283 \times 10^{-5}$$

$$V_u = 6.189 \times 10^{-11}$$

$$\text{Control } x2 = 10.566 \times 10^{-5}$$

$$t = \text{NA}$$

$$\phi = \text{NA}$$

$$u = 5.283 \text{ to } 5.601 \times 10^{-5}$$

TABLE 118
Maize waxy Locus Assay

Pesticide Name Bladex (Cyanazine)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
966	111	360,558	30.79
935-1	27	82,132	32.87
935-2	6	28,545	21.02
Totals	144	471,235	

$$p_w = 30.56 \times 10^{-5}$$

$$V_w = 2.846 \times 10^{-9}$$

$$p_u = 28.25 \times 10^{-5}$$

$$V_u = 1.341 \times 10^{-9}$$

$$\text{Control } x^2 = + (28.25 > 10.566)$$

$$t = + (9.75) P < 0.001$$

$$\phi = + (16.13)$$

$$u = 28.25 \text{ to } 30.56 \times 10^{-5}$$

TABLE 119
Maize waxy Locus Assay

Pesticide Name Cycle (Procyazine)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
933	2	69,230	2.889
934	11	171,785	6.403
Totals	13	241,015*	

$$p_w = 5.394 \times 10^{-5}$$

$$V_w = 1.059 \times 10^{-9}$$

$$p_u = 4.646 \times 10^{-5}$$

$$V_u = 3.087 \times 10^{-10}$$

$$\text{Control } x^2 = - (4.646 < 10.566)$$

$$t = -(0.34)$$

$$\phi = -(0.27)$$

$$u = 4.646 \text{ to } 5.394 \times 10^{-5}$$

TABLE 120
Maize waxy Locus Assay

Pesticide Name Modown (Bifenox)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
975	61	545,242	11.19
976-1	12	169,434	7.082
976-2	38	451,059	8.425
976-3	21	220,588	9.520
Totals	132	1,386,323	

$$p_w = 9.522 \times 10^{-5}$$

$$v_w = 3.786 \times 10^{-10}$$

$$p_u = 9.054 \times 10^{-5}$$

$$v_u = 7.553 \times 10^{-11}$$

$$\text{Control } x^2 = - (9.054 < 10.566)$$

$$t = + (2.84) \text{ } P < 0.01$$

$$\phi = - (4.40)$$

$$u = 9.054 \text{ to } 9.522 \times 10^{-5}$$

TABLE 121
Maize waxy Locus Assay

Pesticide Name SD50093

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
988-1	21	223,492	9.396
988-3	109	34,615	314.9
988-4	17	115,240	14.75
Totals	147	373,347	

$$p_w = 39.37 \times 10^{-5}$$

$$V_w = 3.499 \times 10^{-8}$$

$$p_u = 113.0 \times 10^{-5}$$

$$V_u = 1.019 \times 10^{-6}$$

$$\text{Control } x^2 = + (39.37 > 10.566)$$

$$t = + (2.07) P < 0.05$$

$$\phi = + (19.34)$$

$$u = 39.37 \text{ to } 113.0 \times 10^{-5}$$

TABLE 122
Maize waxy Locus Assay

Pesticide Name Dual + Banvel (Metolachlor & Dicamba)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency (x10 ⁻⁵)
997	28	361,522	7.745
998-1	10	100,190	9.981
1023-1	26	370,552	7.017
1023-2	6	73,852	8.124
Totals	70	906,116	

$$p_w = 7.725 \times 10^{-5}$$

$$v_w = -1.784 \times 10^{-10}$$

$$p_u = 8.217 \times 10^{-5}$$

$$v_u = 3.986 \times 10^{-11}$$

$$\text{Control } x_2 = - (8.217 < 10.566)$$

$$t = + (2.30) \text{ } P < 0.025$$

$$\phi = - (2.14)$$

$$u = 7.725 \text{ to } 8.217 \times 10^{-5}$$

TABLE 123
Maize waxy Locus Assay

Pesticide Name Dual + Cycle (Metolachlor & Procyazine)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
981-1	16	189,952	8.423
981-2	21	230,480	9.111
981-3	23	189,522	12.14
Totals	60	609,954	

$$p_w = 9.837 \times 10^{-5}$$

$$v_w = 6.193 \times 10^{-11}$$

$$p_u = 9.891 \times 10^{-5}$$

$$v_u = 1.304 \times 10^{-10}$$

$$\text{Control } x^2 = - (9.837 < 10.566)$$

$$t = + (3.02) P < 0.01$$

$$\phi = - (3.63)$$

$$u = 9.837 \text{ to } 9.891 \times 10^{-5}$$

TABLE 124
Maize waxy Locus Assay

Pesticide Name Lasso + Banvel (Alachlor & Dicamba)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1028-1	25	575,447	4.344
1028-2	16	551,045	2.904
1028-3	14	311,965	4.488
Totals	55	1,438,457	

$$p_w = 3.824 \times 10^{-5}$$

$$v_w = 5.004 \times 10^{-12}$$

$$p_u = 3.912 \times 10^{-5}$$

$$v_u = 2.557 \times 10^{-11}$$

$$\text{Control } x^2 = - (3.824 < 10.566)$$

$$t = - (0.96)$$

$$\phi = - (2.50)$$

$$u = 3.824 \text{ to } 3.912 \times 10^{-5}$$

TABLE 125
Maize waxy Locus Assay

Pesticide Name : Modown + Lasso (Bifenox & Alachlor)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1015-1	54	581,037	9.294
1015-2	24	484,072	4.958
1015-3	12	214,247	5.601
1016-1	4	50,095	7.985
1016-2	3	54,395	5.515
Totals	97	1,383,846	

$$p_w = 7.009 \times 10^{-5}$$

$$v_w = 4.634 \times 10^{-10}$$

$$p_u = 6.960 \times 10^{-5}$$

$$v_u = 1.029 \times 10^{-5}$$

$$\text{Control } x^2 = -(6.960 < 10.566)$$

$$t = - (1.13)$$

$$\phi = - (1.65)$$

$$u = 6.960 \text{ to } 7.009 \times 10^{-5}$$

TABLE 126
Maize waxy Locus Assay

Pesticide Name Modown + Lasso (Bifenox & Alachlor)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1003	28	613,825	4.562
1004-1	22	496,220	4.434
1004-2	1	21,500	4.651
1004-3	14	400,007	3.500
Totals	65	1,531,552	

$$p_w = 4.244 \times 10^{-5}$$

$$V_w = 3.443 \times 10^{-11}$$

$$p_u = 4.287 \times 10^{-5}$$

$$V_u = 7.076 \times 10^{-12}$$

$$\text{Control } x^2 = - (4.287 < 10.566)$$

$$t = - (0.82)$$

$$\phi = - (1.94)$$

$$u = 4.244 \text{ to } 4.287 \times 10^{-5}$$

TABLE 127
Maize waxy Locus Assay

Pesticide Name Herbicide Controls (1977)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1188-1	7	159,207	4.397
1188-2	7	88,687	7.893
1188-3	2	131,580	1.520
1188-6	9	284,015	3.169
1196-1	13	239,080	5.438
1196-2	4	141,087	2.648
1196-3	1	202,422	0.494
1196-4	6	77,615	7.730
1221-1	3	91,805	3.268
1221-2	5	137,707	3.631
1221-3	20	217,902	9.178
1221-4	8	189,415	4.224
1221-5	11	232,307	4.735
1221-6	2	185,760	1.077
Totals	98	2,388,539	

$$p_w = 4.103 \times 10^{-5}$$

$$V_w = 4.917 \times 10^{-11}$$

$$p_u = 4.243 \times 10^{-5}$$

$$V_u = 4.838 \times 10^{-11}$$

$$\text{Control } x_2 = 8.486 \times 10^{-5}$$

$$t = \text{NA}$$

$$\phi = \text{NA}$$

$$u = 4.103 \text{ to } 4.243 \times 10^{-5}$$

TABLE 128
Maize waxy Locus Assay

Pesticide Name Atrazine

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1248-1	12	186,190	6.445
1248-2	25	135,773	18.41
1248-3	11	151,038	7.283
1248-4	8	96,643	8.278
1248-5	11	181,997	6.044
1248-6	14	198,553	7.051
Totals	81	950,194	

$$p_w = 8.525 \times 10^{-5}$$

$$V_w = 1.668 \times 10^{-10}$$

$$p_u = 8.919 \times 10^{-5}$$

$$V_u = 3.701 \times 10^{-10}$$

$$\text{Control } x^2 = + (8.525 > 8.486)$$

$$t = + (2.88) \text{ } P < 0.005$$

$$\phi = + (4.90)$$

$$u = 8.525 \text{ to } 8.919 \times 10^{-5}$$

TABLE 129
Maize waxy Locus Assay

Pesticide Name Bladex (Cyanazine)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1252-1	16	136,740	11.701
1252-2	40	157,380	25.416
1252-3	20	142,652	14.020
1252-4	18	106,532	16.896
1252-5	21	129,752	16.185
1252-6	18	139,965	12.860
1252-7	8	128,678	6.217
Totals	141	941,699	

$$p_w = 14.97 \times 10^{-5}$$

$$V_w = 7.066 \times 10^{-10}$$

$$p_u = 14.76 \times 10^{-5}$$

$$V_u = 4.920 \times 10^{-10}$$

$$\text{Control } x^2 = + (14.76 > 8.486)$$

$$t = + (5.77) P < 0.001$$

$$\phi = + (10.47)$$

$$u = 14.76 \text{ to } 14.97 \times 10^{-5}$$

TABLE 130
Maize waxy Locus Assay

Pesticide Name Dual (Metolachlor)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1269-1	1	141,255	7.079
1269-2	1	212,205	0.471
1269-3	6	110,510	5.429
1269-4	15	136,847	10.96
1269-5	1	151,145	0.662
1269-6	7	338,195	2.070
Totals	31	1,090,157	

$$p_w = 2.844 \times 10^{-5}$$

$$v_w = 1.303 \times 10^{-10}$$

$$p_u = 4.445 \times 10^{-5}$$

$$v_u = 2.870 \times 10^{-10}$$

$$\text{Control } x^2 = - (2.844 < 8.486)$$

$$t = - (0.13)$$

$$\phi = - (1.88)$$

$$u = 2.844 \text{ to } 4.445 \times 10^{-5}$$

TABLE 131
Maize waxy Locus Assay

Pesticide Name Dual (Metolachlor)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1268-1	3	171,462	1.750
1268-2	6	129,430	4.636
1268-3	4	153,187	2.611
1268-4	5	194,145	2.575
1268-5	9	184,040	4.890
1268-6	12	127,065	9.444
Totals	39	959,329	

$$p_w = 4.065 \times 10^{-5}$$

$$v_w = 6.683 \times 10^{-11}$$

$$p_u = 4.318 \times 10^{-5}$$

$$v_u = 1.308 \times 10^{-10}$$

$$\text{Control } x^2 = - (4.065 < 8.486)$$

$$t = - (0.06)$$

$$\phi = - (0.14)$$

$$u = 4.065 \text{ to } 4.318 \times 10^{-5}$$

TABLE 132
Maize waxy Locus Assay

Pesticide Name Eradicane (EPTC)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1194-1	9	109,542	8.216
1194-2	7	112,015	6.249
1194-3	9	82,775	10.87
1194-4	1	152,435	0.656
1194-5	7	142,975	4.896
1194-6	2	209,195	0.956
Totals	35	808,937	

$$p_w = 4.327 \times 10^{-5}$$

$$v_w = 7.942 \times 10^{-11}$$

$$p_u = 5.307 \times 10^{-5}$$

$$v_u = 2.701 \times 10^{-10}$$

$$\text{Control } x^2 = - (4.327 < 8.486)$$

$$t = - (0.71)$$

$$\phi = - (0.17)$$

$$u = 4.327 \text{ to } 5.307 \times 10^{-5}$$

TABLE 133
Maize waxy Locus Assay

Pesticide Name Lasso (Alachlor)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1265-1	17	306,698	5.543
1265-2	6	286,272	2.096
1265-3	10	196,940	5.078
1265-4	8	136,740	5.851
1265-5	10	163,078	6.132
1265-6	6	264,342	2.270
Totals	57	1,354,070	

$$p_w = 4.210 \times 10^{-5}$$

$$V_w = 2.680 \times 10^{-11}$$

$$p_u = 4.495 \times 10^{-5}$$

$$V_u = 5.554 \times 10^{-11}$$

$$\text{Control } x_2 = - (4.210 < 8.486)$$

$$t = - (0.21)$$

$$\phi = - (0.07)$$

$$u = 4.210 \text{ to } 4.495 \times 10^{-5}$$

TABLE 134
Maize waxy Locus Assay

Pesticide Name SD50093

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1255-1	18	187,372	9.073
1255-2	22	181,890	12.095
1255-3	31	287,670	10.780
1255-4	55	158,670	34.663
1255-5	28	219,730	12.743
1255-6	32	109,220	29.299
Totals	186	1,144,552	

$$p_w = 16.25 \times 10^{-5}$$

$$v_w = 3.359 \times 10^{-10}$$

$$p_u = 18.11 \times 10^{-5}$$

$$v_u = 1.999 \times 10^{-9}$$

$$\text{Control } x_2 = + (16.25 > 8.486)$$

$$t = + (4.60) P < 0.001$$

$$\phi = + (11.86)$$

$$u = 16.25 \text{ to } 18.11 \times 10^{-5}$$

TABLE 135
Maize waxy Locus Assay

Pesticide Name Simazine

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1254-1	34	178,987	19.00
1254-2	15	148,780	10.08
1254-3	6	113,842	5.270
1254-4	19	89,333	21.27
1254-5	10	124,807	8.012
1254-6	3	166,517	1.802
1254-7	20	162,755	12.29
Totals	107	985,021	

$$p_w = 10.860 \times 10^{-5}$$

$$v_w = 6.992 \times 10^{-10}$$

$$p_u = 11.10 \times 10^{-5}$$

$$v_u = 7.102 \times 10^{-10}$$

$$\text{Control } x_2 = + (10.86 > 8.486)$$

$$t = + (3.29)$$

$$\phi = + (7.16)$$

$$u = 10.86 \text{ to } 11.10 \times 10^{-5}$$

TABLE 136
Maize waxy Locus Assay

Pesticide Name Sutan (Butylate)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1195-1	8	88,795	9.010
1195-2	6	100,190	5.989
1195-3	6	59,555	10.07
1195-4	5	171,570	2.914
1195-5	3	178,987	1.676
1195-6	9	140,825	6.391
1195-7	15	168,130	8.922
Totals	52	908,052	

$$p_w = 5.727 \times 10^{-5}$$

$$v_w = 6.672 \times 10^{-11}$$

$$p_u = 6.425 \times 10^{-5}$$

$$v_u = 1.459 \times 10^{-10}$$

$$\text{Control } x^2 = - (5.727 < 8.486)$$

$$t = - (1.68)$$

$$\phi = - (1.86)$$

$$u = 5.727 \text{ to } 6.425 \times 10^{-5}$$

TABLE 137
Maize waxy Locus Assay

Pesticide Name Dual + Atrazine (Metolachlor & Atrazine)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1223-1	13	185,115	7.023
1223-2	7	44,935	15.58
1223-3	8	128,248	6.238
1223-4	36	233,168	15.01
1223-5	35	199,842	17.51
Totals	99	791,308	

$$p_w = 12.51 \times 10^{-5}$$

$$v_w = 1.047 \times 10^{-9}$$

$$p_u = 12.27 \times 10^{-5}$$

$$v_u = 5.492 \times 10^{-10}$$

$$\text{Control } x^2 = + (12.27 > 8.486)$$

$$t = + (4.52) P < 0.001$$

$$\phi = (8.15)$$

$$u = 12.27 \text{ to } 12.51 \times 10^{-5}$$

TABLE 138
Maize waxy Locus Assay

Pesticide Name Dual + Banvel (Metolachlor & Dicamba)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1243-1	23	185,545	12.40
1243-2	14	227,685	6.149
1243-3	11	224,998	4.889
1243-4	7	113,950	6.143
Totals	55	752,178	

$$p_w = 7.312 \times 10^{-5}$$

$$v_w = 2.252 \times 10^{-10}$$

$$p_u = 7.395 \times 10^{-5}$$

$$v_u = 2.871 \times 10^{-10}$$

$$\text{Control } x^2 = - (7.312 < 8.486)$$

$$t = + (2.01) \text{ P. } < 0.05$$

$$\phi = - (3.38)$$

$$u = 7.312 \text{ to } 7.395 \times 10^{-5}$$

TABLE 139
Maize waxy Locus Assay

Pesticide Name Dual + Bladex (Metolachlor & Cyanazine)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1233-1	18	79,228	22.72
1233-2	18	97,932	18.38
1233-3	9	140,288	7.841
1233-4	2	28,810	6.942
1233-5	3	85,892	3.493
1233-6	6	84,495	7.101
Totals	56	516,645	

$$p_w = 10.84 \times 10^{-5}$$

$$v_w = 8.334 \times 10^{-10}$$

$$p_u = 11.08 \times 10^{-5}$$

$$v_u = 9.660 \times 10^{-10}$$

$$\text{Control } x_2 = + (10.84 > 8.486)$$

$$t = + (3.06) \text{ } P < 0.001$$

$$\phi = + (5.92)$$

$$u = 10.84 \text{ to } 11.08 \times 10^{-5}$$

TABLE 140
Maize waxy Locus Assay

Pesticide Name Eradicane + Atrazine

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1190-1	11	123,302	8.920
1190-2	97	239,725	40.463
1190-3	28	168,130	16.65
1190-4	15	221,665	6.767
1190-5	7	195,220	3.586
1190-6	8	94,170	8.495
1190-7	17	117,068	14.52
Totals	183	1,159,280	

$$p_w = 15.79 \times 10^{-5}$$

$$v_w = 5.021 \times 10^{-9}$$

$$p_u = 14.20 \times 10^{-5}$$

$$v_u = 2.200 \times 10^{-9}$$

$$\text{Control } x^2 = + (14.20 > 8.486)$$

$$t = + (2.95) P < 0.001$$

$$\phi = + (11.53)$$

$$u = 14.20 \text{ to } 15.79 \times 10^{-5}$$

TABLE 141
Maize waxy Locus Assay

Pesticide Name Eradicane + Bladex (Eradicane & Cyanazine)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1189-1	9	115,240	7.810
1189-2	18	128,032	14.06
1189-3	11	99,008	11.11
1189-5	14	217,472	6.438
1189-6	8	181,568	4.406
1189-7	16	141,900	11.28
Totals	76	883,220	

$$p_w = 8.605 \times 10^{-5}$$

$$v_w = 9.896 \times 10^{-12}$$

$$p_u = 9.183 \times 10^{-5}$$

$$v_u = 2.139 \times 10^{-10}$$

$$\text{Control } x^2 = + (8.605 > 8.486)$$

$$t = + (3.48) P < 0.001$$

$$\phi = + (4.87)$$

$$u = 8.605 \text{ to } 9.183 \times 10^{-5}$$

TABLE 142
Maize waxy Locus Assay

Pesticide Name Propachlor + Bladex (Propachlor & Cyanazine)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1235-1	20	162,648	12.30
1235-2	4	211,560	1.891
1235-3	9	150,392	5.984
1235-4	21	142,330	14.75
1235-5	4	228,438	1.751
1235-6	15	265,418	5.654
Totals	73	1,160,786	

$$p_w = 6.289 \times 10^{-5}$$

$$v_w = 2.186 \times 10^{-10}$$

$$p_u = 7.055 \times 10^{-5}$$

$$v_u = 4.821 \times 10^{-10}$$

$$\text{Control } x^2 = - (6.289 < 8.486)$$

$$t = - (1.60)$$

$$\phi = - (2.70)$$

$$u = 6.289 \text{ to } 7.055 \times 10^{-5}$$

TABLE 143
Maize waxy Locus Assay

Pesticide Name Sutan + Atrazine (Butylate & Atrazine)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1186-1	13	159,960	8.127
1186-2	22	161,895	13.59
1186-3	25	202,100	12.37
1186-4	13	258,000	5.039
1186-5	21	236,608	9.721
1186-6	8	218,332	3.664

Totals	102	1,236,895
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$$p_w = 8.246 \times 10^{-5}$$

$$v_w = 1.298 \times 10^{-10}$$

$$p_u = 8.752 \times 10^{-5}$$

$$v_u = 2.583 \times 10^{-10}$$

$$\text{Control } x^2 = - (8.246 < 8.486)$$

$$t = + (3.05) \text{ } P < 0.001$$

$$\phi = + (4.96)$$

$$u = 8.246 \text{ to } 8.752 \times 10^{-5}$$

TABLE 144
Maize waxy Locus Assay

Pesticide Name Sutan + Bladex (butylate & Cyanazine)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
1187-1	17	256,280	5.463
1186-2	8	144,265	5.545
1187-3	10	101,480	9.854
1187-4	3	133,300	2.251
1186-5	16	192,425	8.315
1186-6	6	190,168	3.155
Totals	60	1,017,918	

$$p_w = 5.894 \times 10^{-5}$$

$$v_w = 1.199 \times 10^{-10}$$

$$p_u = 5.764 \times 10^{-5}$$

$$v_u = 1.417 \times 10^{-10}$$

$$\text{Control } x^2 = - (5.894 < 8.486)$$

$$t = - (1.16)$$

$$\phi = - (2.14)$$

$$u = 5.764 \text{ to } 5.894 \times 10^{-5}$$

TABLE 145
Maize waxy Locus Assay

Pesticide Name 1978 Control

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
4060-1	6	271,330	2.211
4060-2	16	216,720	7.383
4060-3	1	160,282	0.624
4060-4	2	211,668	0.945
4060-5	3	139,212	2.155
4060-6	7	168,990	4.142
Totals	35	1,168,202	

$$p_w = 2.996 \times 10^{-5}$$

$$v_w = 1.248 \times 10^{-10}$$

$$p_u = 2.910 \times 10^{-5}$$

$$v_u = 1.056 \times 10^{-10}$$

$$\text{Control } x_2 = 5.820 \times 10^{-5}$$

$$t = \text{NA}$$

$$\phi = \text{NA}$$

$$u = 2.910 \text{ to } 2.996 \times 10^{-5}$$

TABLE 146
Maize waxy Locus Assay

Pesticide Name Banvel (Dicamba)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
4059-1	8	245,852	3.254
4059-2	6	186,835	3.211
4059-3	8	219,085	3.652
4059-4	8	223,278	3.583
4059-5	3	274,770	1.092
4059-6	2	287,455	0.696
Totals	35	1,437,275	

$$p_w = 2.435 \times 10^{-5}$$

$$v_w = 1.905 \times 10^{-11}$$

$$p_u = 2.581 \times 10^{-5}$$

$$v_u = 2.924 \times 10^{-11}$$

$$\text{Control } x_2 = - (2.435 < 5.82)$$

$$t = - (0.28)$$

$$\phi = - (0.99)$$

$$u = 2.435 \text{ to } 2.581 \times 10^{-5}$$

TABLE 147
Maize waxy Locus Assay

Pesticide Name Ramrod (Propachlor)

Experiment No.	No. of Mutant Pollen Grains	Estimated No. of Pollen Grains Analyzed	Frequency ($\times 10^{-5}$)
4061-1	4	213,172	1.876
4061-2	21	200,702	4.484
4061-3	6	219,300	2.736
4061-4	8	190,275	4.204
4061-5	6	150,178	3.995
4061-6	3	159,745	1.878
Totals	48	1,133,372	

$$p_w = 4.235 \times 10^{-5}$$

$$v_w = 1.977 \times 10^{-10}$$

$$p_u = 3.196 \times 10^{-5}$$

$$v_u = 2.335 \times 10^{-11}$$

$$\text{Control } x_2 = - (3.196 < 5.82)$$

$$t = - (0.25)$$

$$\phi = - (1.46)$$

$$u = 3.196 \text{ to } 4.235 \times 10^{-5}$$

TABLE 148
Sources of Pesticides

Pesticide	Source	Lot Number
Chlordane C	Illinois Natural History Survey	NA
Chlordane T	Illinois Natural History Survey	NA
Terbufos C	Illinois Natural History Survey	NA
Terbufos T	Illinois Natural History Survey	AC1947-114
Fonofos C	Illinois Natural History Survey	NA
Fonofos T	Illinois Natural History Survey	106-B
Heptachlor C	Illinois Natural History Survey	NA
Heptachlor T	Illinois Natural History Survey	NA
Carbofuran C	Illinois Natural History Survey	NA
Carbofuran T	Illinois Natural History Survey	NA
Chlorpyrifos C	Illinois Natural History Survey	NA
Chlorpyrifos T	Illinois Natural History Survey	Dow Co 214
Ethoprop C	Illinois Natural History Survey	NA
Ethoprop T	Illinois Natural History Survey	NA
Phorate C	Illinois Natural History Survey	NA
Phorate T	Illinois Natural History Survey	SPS-6667
Curacron C	Illinois Natural History Survey	NA
Curacron T	Illinois Natural History Survey	12223
Metham C	Illinois Natural History Survey	NA
Metham T	Illinois Natural History Survey	2050012
Cyanazine C	Agronomy Dept., U. of IL	NA
Cyanazine T	Shell Development Co.	AC-19,020;251273

TABLE 148 (Contd)

Pesticide	Source	Lot Number
Eradicane C	Agronomy Dept., U. of IL	NA
Eradicane T	Stauffer Chemical Co.	NA
Alachlor C	Monsanto Co.	MHI-1
Alachlor T	Monsanto Co.	MHF-183
Bifenox C	Agronomy Dept., U. of IL	NA
Bifenox T	Mobil Chem. Co.	NA
Procyazine C	Agronomy Dept., U. of IL	NA
Procyazine T	Ciba-Geigy Co.	FL-752295
Metolachlor C	Agronomy Dept., U. of IL	NA
Metolachlor T	Ciba-Geigy Co.	FL-760037
Propachlor C	Agronomy Dept., U. of IL	NA
Propachlor T	Monsanto Co.	XHH-124
Simazine C	Agronomy Dept., U. of IL	NA
Simazine T	Ciba-Geigy Co.	FL-750336
Atrazine C	Agronomy Dept., U. of IL	NA
Atrazine T	Ciba-Geigy Co.	FL-761261
Butylate C	Agronomy Dept., U. of IL	NA
Butylate T	Stauffer Chemical Co.	NA
Dicamba C	Agronomy Dept., U. of IL	NA
Dicamba T	Velsicol Chem. Co.	NA

C = commercial grade, T = technical grade, NA = not available